FLYING AND POPULAR AVIATION

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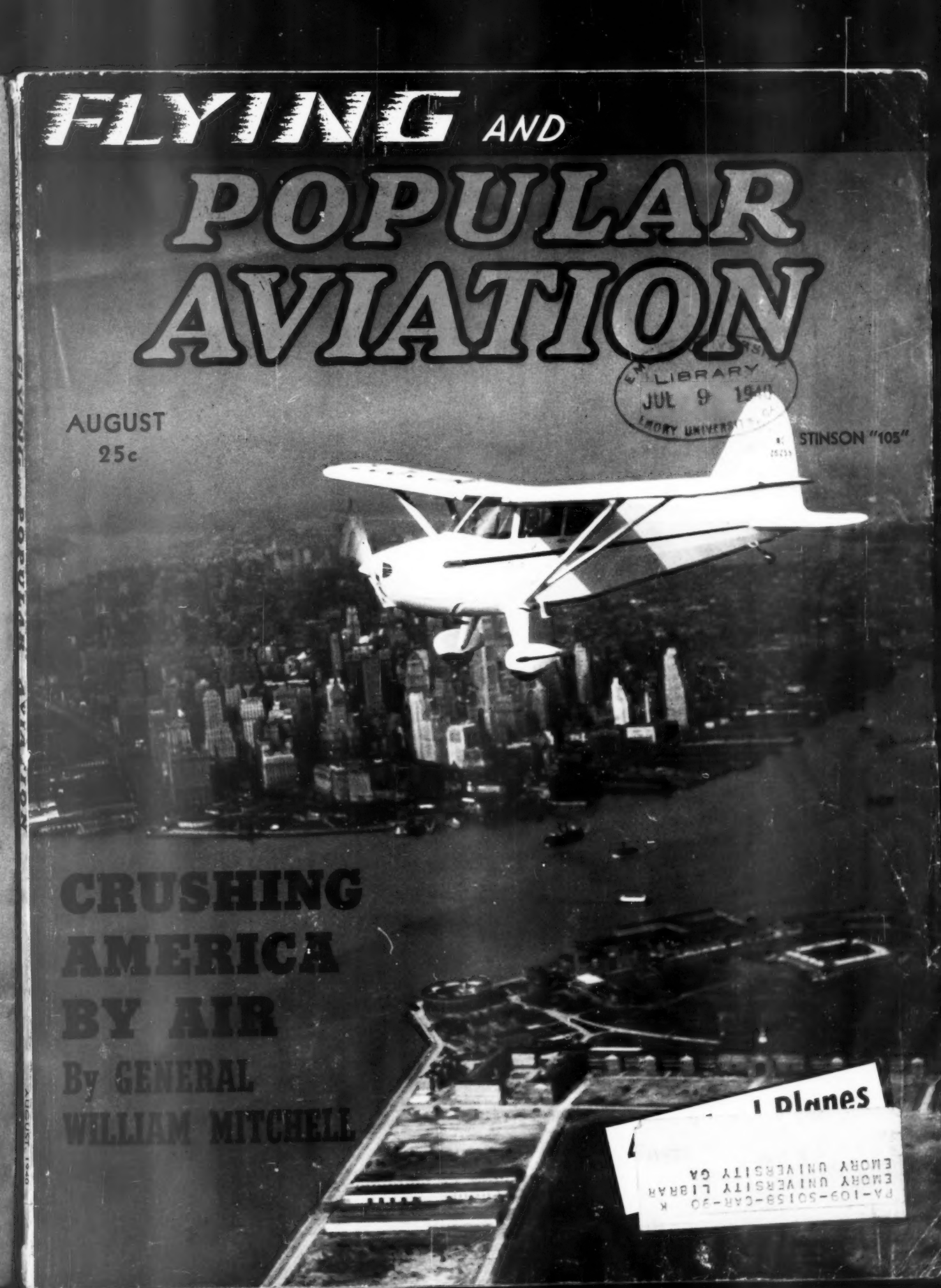

CRUSHING AMERICA BY AIR

By GENERAL WILLIAM MITCHELL

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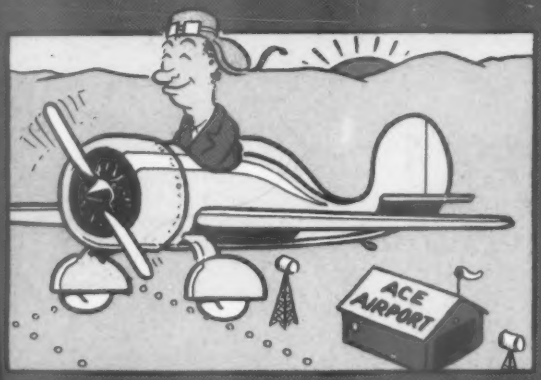
FLYING AND POPULAR AVIATION
AUGUST 1940

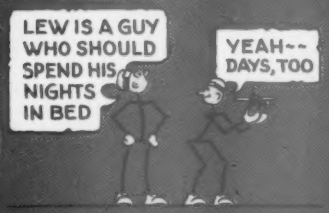
DON'T BE A SCREWBIRD!

Leave Night Flying to Owls and Experienced Pilots

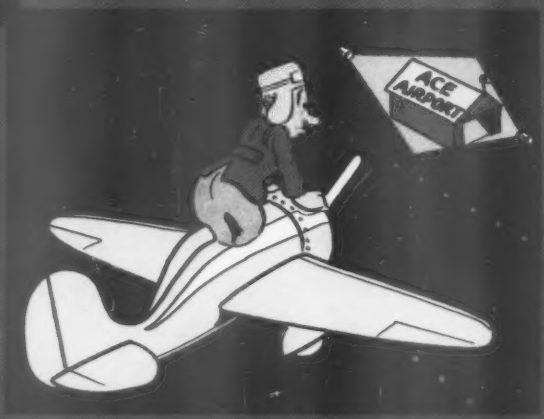


1. As if he couldn't get lost easily enough in the daylight, Lew Screwbird decides on a cross-country night flight. And why not? He knows the country well.

2. Comes the dark, and Lew's road map is no help at all . . . he can't even find his wing tips, much less his whereabouts. So he just keeps flying around.



Stick to daytime flying, unless both your plane and yourself are especially equipped for night flying. As the Air Safety Board says—"Be certain—'I think I can make it' belongs on the list of famous last words."



3. Airport, airport, here I come; right back where I started from. And won't Lew be surprised when he finds that out. It looked strange to him at night. In the matter of night flying, Lew Screwbird got nowhere fast.

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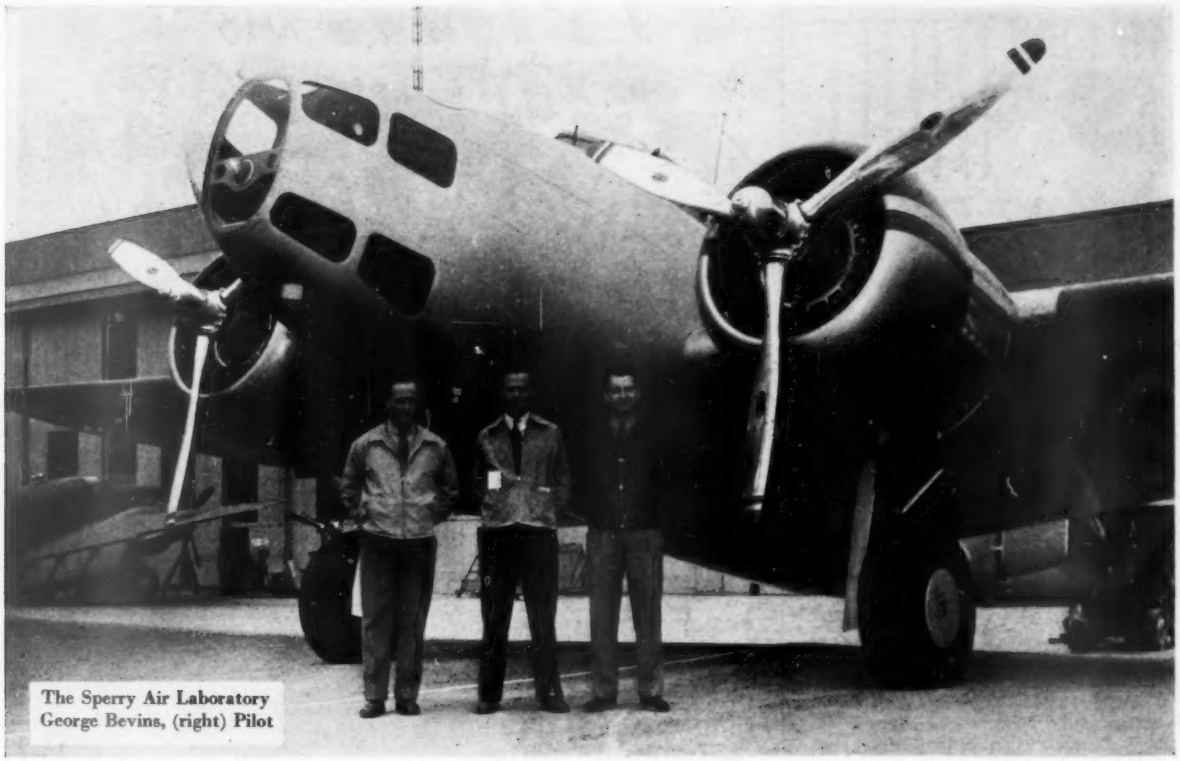

The Sperry Air Laboratory
George Bevins, (right) Pilot

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As ONE of many young men thinking and dreaming about your future success in aviation, stories of successful flyers and aviation executives fire you with ambition. But remember, that behind every success lies proper training—the foundation that equips you to forge ahead to leadership.

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The story of Mr. Bevins is only one of hundreds of other successful careers of Parks graduates. For Parks educational methods are designed to train you to become a potential leader, to do independent and original thinking.

Striking evidence of the industry's recognition of the value of Parks training is found in this fact—air lines are now engaging Parks trained men as co-pilots of commercial transports *directly upon graduation from Parks.*

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THE people of the United States are on a spot, the likes of which would make a Capone appear a rank amateur. This country sorely needs police protection against international banditry. At the moment we can manage to scrape up the equivalent of one medium-sized cap pistol. The United States has a pipsqueak air force and there is a pair of gangsters in Europe who know it. Obviously, this country's immediate need—not for the 1942 session of Congress, but right now; tomorrow—is expansion of our air forces until even a bullying gangster would hesitate carrying out his threats. President Roosevelt temporarily cheered a jittery public when he trumpeted for 50,000 warplanes. What specifically did the President mean by 50,000 warplanes? The average American probably thought in terms of 50,000 bombers, or 25,000 bombers and 25,000 fighters. Even weeks are preciously vital today; consider the havoc Hitler has wreaked throughout Europe in just a few days. We need the biggest possible air force in the shortest possible time. Every aircraft manufacturer in the country is ready and waiting to build the finest warplanes on earth. It is entirely possible for our present aircraft manufacturers to build about 54,000 warplanes annually merely by normal expansion of present facilities. It remains only for the United States Government to take advantage of this capacity. This volume, of course, excludes automobile manufacturers. If Henry Ford says he can build 1,000 warplanes a day we are not inclined to sneer at him. If the Government gave only the auto men a clear-cut production job to do, our air forces would eclipse those of Germany, the Allies and Russia combined *within two production months.*

* * *

WE like to toss around in our minds the prospect of the auto manufacturers going into mass production of warplanes. If what Mr. Ford says is true—and who would know better than he?—the United States should have the whoppingest air force ever conceived by humans. If Ford, General Motors and Chrysler alone built 1,000 per day that would be 90,000 warplanes in one peak month! Or, for a year, 1,080,000 ships. Plus the present aviation industry's 54,000, bringing our ethereal grand total to 1,134,000 aircraft in one year! Obviously, such a thing really happening is inconceivable. Even if we got that many planes, where could we possibly find a cool 2,000,000 capable military pilots? Anyway, even half that number would make the German air force look like an amateur outing. It's a nice dream, though.

(*Continued on page* 62)

FLYING AND POPULAR AVIATION

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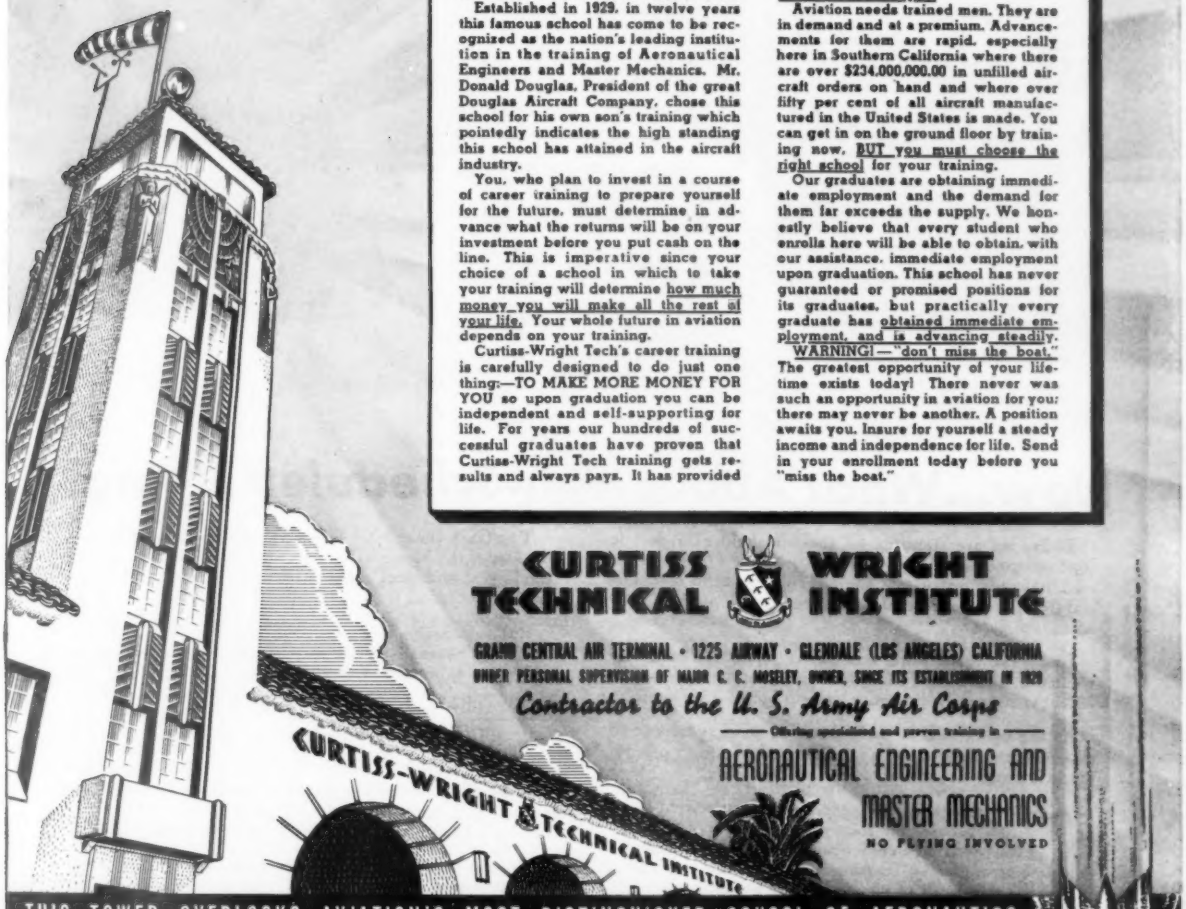

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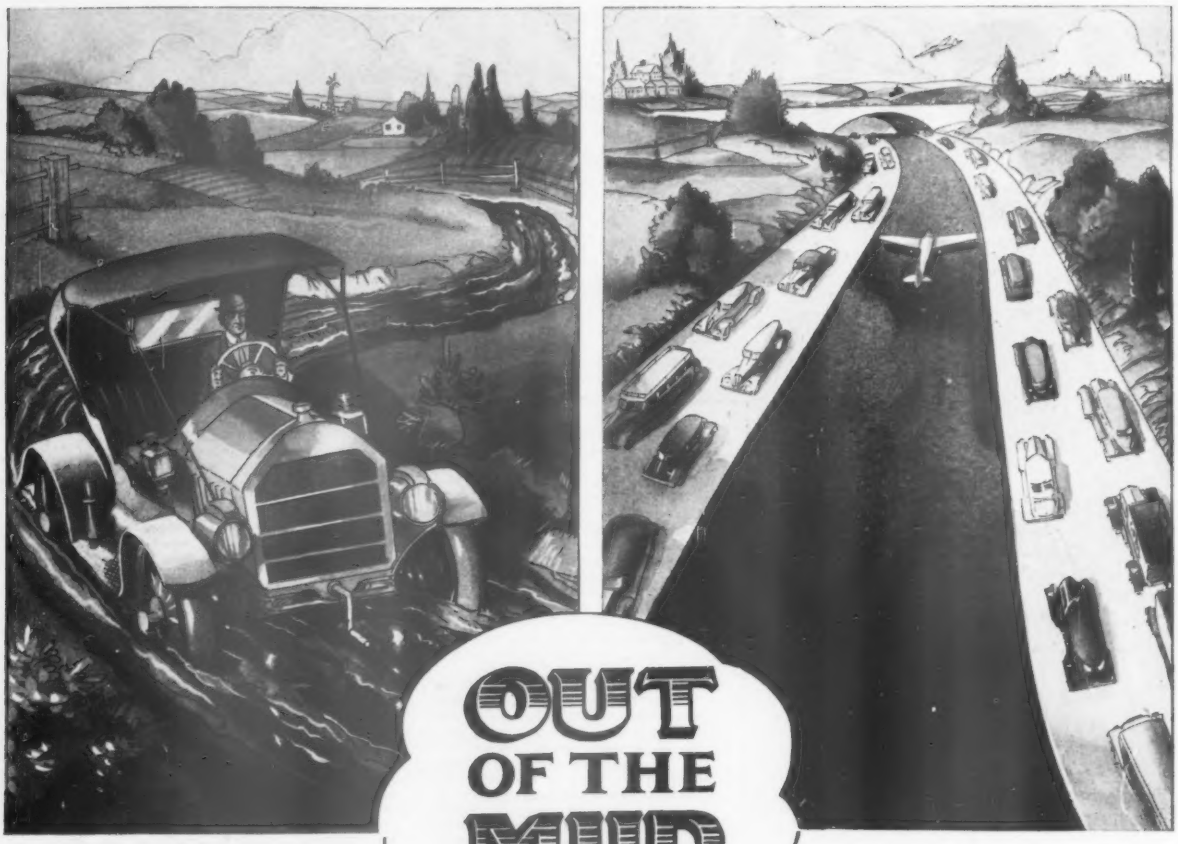

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Why does a California Flyers man stand so high? It is obvious once you have heard the complete story of this famous school. Its founders believe that aviation should be taught in a school where the student remained an individual—learning aviation as it pertains to his individual ambitions and qualifications, and by so doing preparing *him* for the responsibilities of leadership. This way the graduate is prepared to meet today's aviation problems and to contribute to tomorrow's aviation advancement. This is the way today's leaders learned. Only this way can a training program be built for the industry, on industry's specifications. They believe too, that the entire field of aeronautics:—engineering, mechanics and piloting are all closely interwoven and that a student should train in a school that teaches all of these important divisions. Above all, they believe that aviation should be taught in an environment of aviation activity, taught where the greatest aviation developments originate, taught where there is the greatest number of men actively engaged in aviation. This is why California Flyers is located in the heart of the world's aviation capital on the world's busiest testing field.

If this is the kind of school that you would like . . . friendly, efficient, modern and thorough; an aeronautical school operated by practical aviation men, you will be most interested in reading the *complete* story of California Flyers in the new 64 page catalog which tells today's story of aviation at work, complete details of the training courses and just what it takes to be a *California Flyers man.*

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Polly Smith Photo.

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The wings he covets are not made of feathers. They are the taut fabric wings of a training plane.

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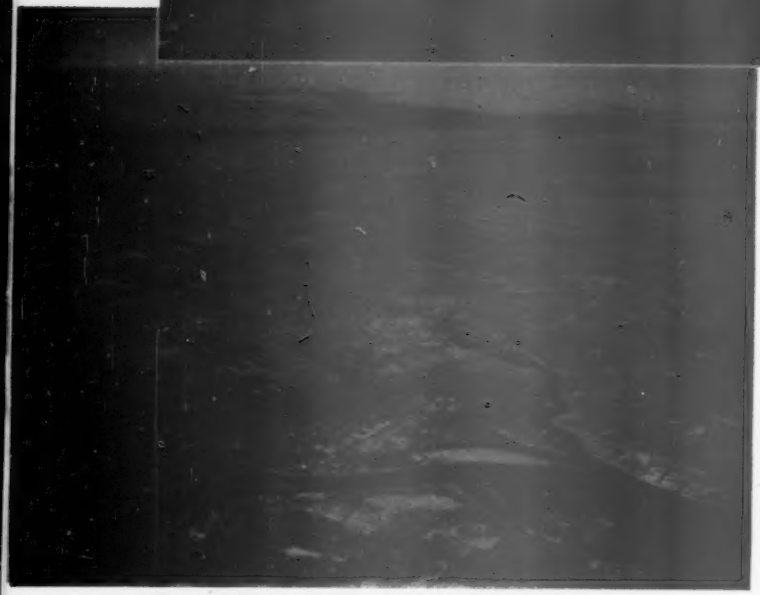
New York City and her vital docks, seen from an approaching airplane above, are practically defenseless from the ground.



The substratosphere bomber—a reality today—sees its objectives like this. Photo shows Washington, D. C., and several states.

CRUSHING AMERICA BY AIR

BY GENERAL WILLIAM MITCHELL

With most of the world again at war, the words of the late Billy Mitchell become almost terrifying. He wrote this article 11 years ago.

EVERY airplane built is an asset for national defense. Each and every one, no matter whether it is called military or commercial, can be used in wartime—either for actual combat or transportation of goods and material, or for the training of pilots. Every air mechanic employed on commercial airways is efficient in case of war. Every airway, every landing field, all the aids to aerial navigation and the weather service, are assets.

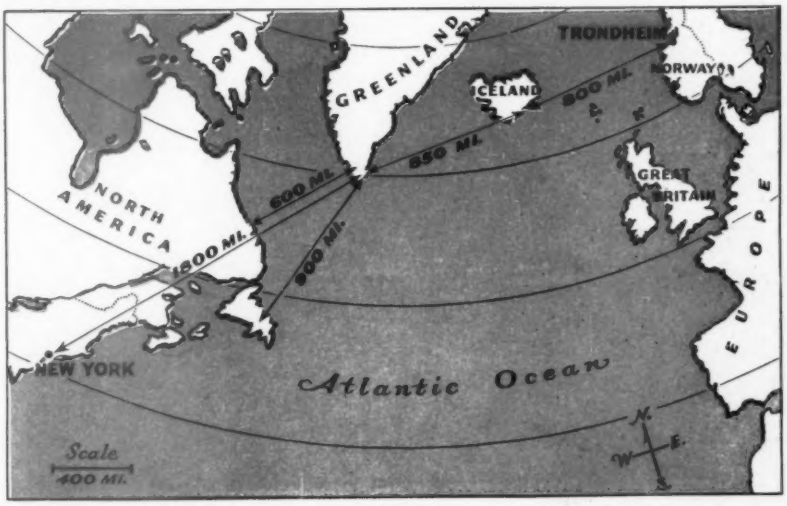
The tremendous military value of air power has burst on the world so suddenly that its realization is difficult for the average citizen. The idea is deeply ingrained into most of us that armies and navies must always conduct our wars, because they have done so from time immemorial. Such, however, is by no means the case today. The Army has lost its mobility and with it the power of effecting a quick decision. To bring a war to a successful conclusion, the vital points of the enemy must be seized or controlled, so as to prevent him from living in his accustomed way and carrying on his usual functions of goverment. Armies were opposed by other armies in the accomplishment of this task. In other words, walls of men were put up in front of the great cities and vital centers to protect them. In the days when populations were not as great per square mile as now, and it was difficult to support armies, the small forces employed were capable of considerable movement, but as time went on the armies grew larger and larger, became more immobile and unwieldy and incapable of striking or acting quickly.

The distance from Washington to Richmond, Virginia, is 121 miles. In the Civil War it took the Union Army about five years to get there. An airplane would have covered the distance in less than one hour. *(30 minutes for the modern bomber.—Ed.)* In the European war the armies faced each other along a 250 mile front. They went backward and forward for about 60 miles until the end of the contest. Men were killed by the thousands by machine gun fire, they were shot up with cannon, stuck with bayonets and devoured by disease. This modern and "humane" warfare could only result in one thing—the utter destruction of all the participants in such a combat. It ceased to be war and was merely a slaughterhouse performance in which no science, art or ingenuity was involved. The European war, except for a few battles at the beginning, was one of the most uninteresting that history gives us.

Armies have now reached a stalemate and the old theory of war, that victory meant the destruction of the hostile main army, is untenable. The idea behind this was that once the army was destroyed, all the vital centers of the opposing country lay open to the invader. Now, however, armies have become mere holders of ground and air power is the only thing that can go quickly and surely to the vital centers of the enemy. If you tie aviation to an army you are going to stop its effectiveness at once.

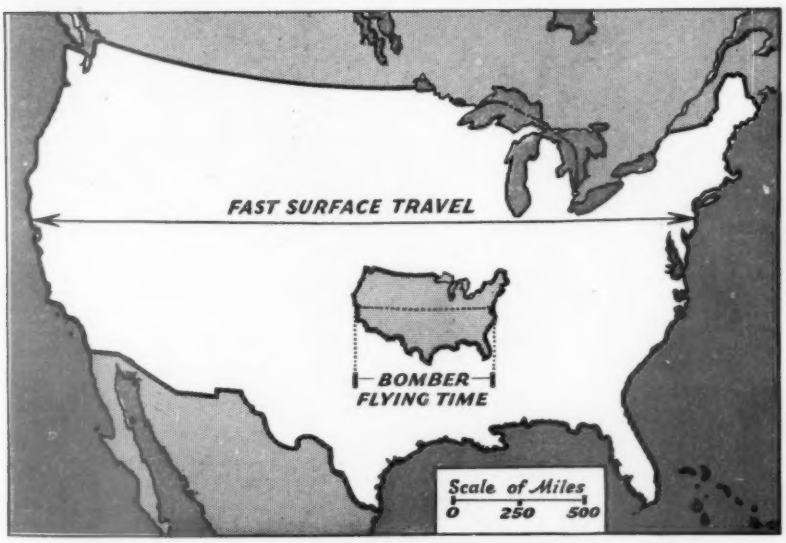
Suppose, for instance, that Chicago and New York were the capitals and vital centers of two opposing states. They are about 800 miles apart. Suppose that the military force of Chicago consisted of a great army of 1,000,000 men with only aviation enough to act as a means of reconnaissance and observation for its infantry and artillery. Suppose that the army of New York consisted of 100,000 men but that they had an air force of 1,000 airplanes capable of flying to Chicago and back and each capable of carrying two tons

(*Continued on page* 58)



Aerial stepping-stones from German-held Norway to the United States are charted above.

The modern bomber shrinks the map by comparison to the fastest surface transportation.



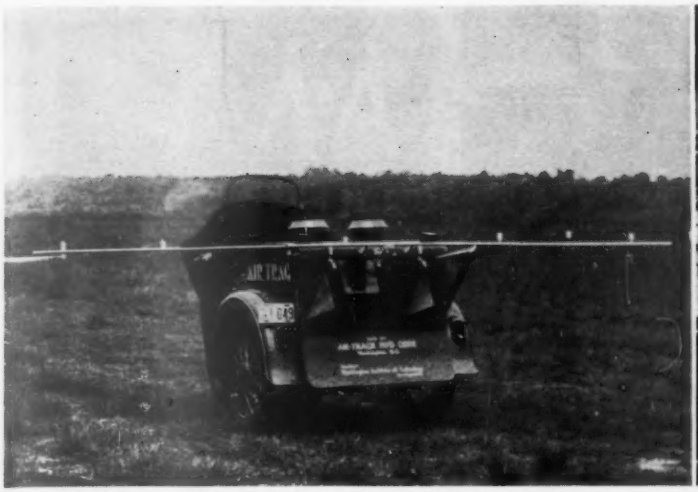
EDITOR'S NOTE

This article, first published in the July, 1929, issue of POPULAR AVIATION, *is reproduced here in its entirety and under the original title. The reader should find many of Mitchell's statements and predictions startling, particularly in light of the present war in Europe. Many of his amazing prophecies have come true today—much to the terror of those who did most to drum the outspoken general out of the U. S. Army. Far from being a professional howler, Billy Mitchell spent almost all of his 57 years in the Army. He was born December 29, 1879, and died February 19, 1936. During the last World War Billy Mitchell was the first American officer to fly over the front lines. He later became chief of the air services of the group of Allied armies in the Argonne offensive. At St. Mihiel he commanded what at that time was the largest aviation concentration in the history of the world. For his bravery and accomplishments in many battles of the war he was awarded the D.S.M., D.S.C. (U.S.), Croix de Guerre with five palms and was a Commander in the French Legion of Honor, a Companion of the British Order of St. Michael and St. George, Commanditore S.S. Maurizio e Lazzaro, War Cross and Grand Officer of the Crown of Italy.*

Zero Zero—BUT SAFE

by

CASS H. MAXWELL



The complete Air Track marker beacon and power supply are in this motorcycle.

This is control and monitor installation of CAA system.

Blind landings will be the next important addition to domestic airline operations. Herewith a roundup of the workable systems.

LANDING blind! . . . A giant airliner, unseeing and unseen, hurtling through storm and clouds to its fog-obscured destination. Invisible tentacles of the radio range reach into the darkness and guide it along its course; calm, unhurried voices speak to the speeding ship, telling it of the weather ahead and of other ships flying in the night.

Across the airliner's course a tall fountain of radio energy gushes into the sky. A tiny light glows on the instrument board and the pilot checks his altitude, reduces his speed and begins the long glide to the invisible airport. Down the gentle slope of the landing beam, the airliner with its human cargo, its engines hushed, slides blindly at 100 m.p.h. At the airport boundary another radio fountain momentarily bathes the ship in its invisible radiance; another light glows on the instrument board and the pilot eases back on the controls, levels off. The huge wing of the airliner sighs through the air and 12 tons of metal and passengers gently settle onto the invisible runway—safely and on time!

In the glowing mist at the edge of the airport lies the passenger terminal and administration building. The airport traffic control tower on the roof is a beehive of orderly activity. Heedless of fog and darkness, every five minutes an airliner takes off or lands, guided with clocklike precision by the miracle-working radio waves.

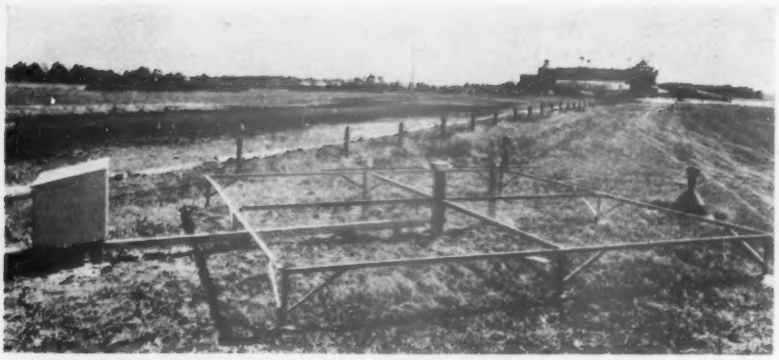
The big news of 1940 is instrument landing. In a few months a network of airports equipped with instrument landing aids will span the country. The air transportation industry will embark on a new era of safety and reliability of schedules—not only by being able to land in any weather, but also by reducing traffic congestion at the airports.

Speeding the air traffic—that is the primary purpose of instrument landing. In fair weather air traffic flows smoothly on even the most overcrowded airways. Each ship aloft is assigned its altitude and lane; each is timed in its progress along the airway, cleared through traffic intersections and brought to its airport of destination.

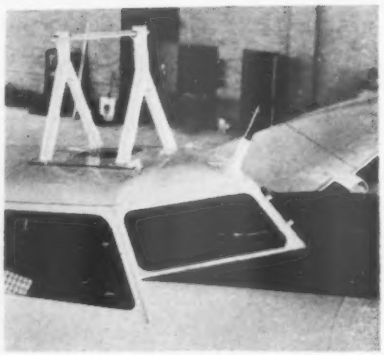
Air traffic congestion exists only at terminal airports, principally in bad weather. In commercial operations the normal good weather traffic capacity of a large modern airport is seldom more than 12 arrivals and 12 departures per hour—one arrival and 12 departures every five minutes. In adverse weather, even with a reasonably high ceiling, the present capacity of an airport drops to *not more than four arrivals and four departures* per hour—one arrival and one departure every 15 minutes.

This is the bottleneck of air traffic. Four landings per hour do not justify an airport. Yet with the present navigational aids even the experienced airline pilots need at least 15 minutes to work

Instrument mounted in Boeing 247D is Air Track system cross-pointer. Pilot is adjusting it.



Many final blind landing experiments of the Civil Aeronautics Authority were run off at Indianapolis airport where complete installation was made (inner marker above).



Special instrument landing antenna above is installed on United Air Lines test ship.

out their information problems and come in for an instrument approach.

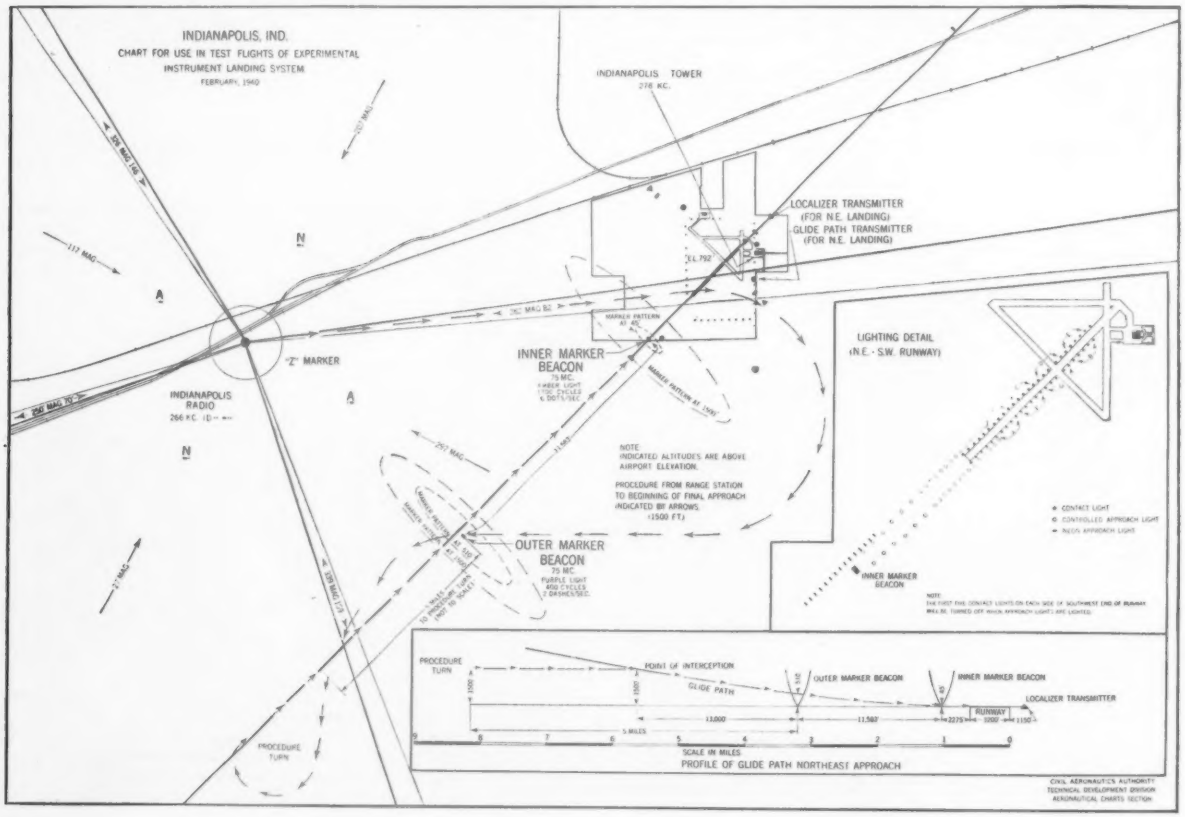
Such delays are bad enough in commercial operations; in military operations delays like this may become critical. It may become necessary to move large numbers of aircraft from one section of the country to another regardless of weather. Ability to land under adverse weather conditions then becomes a pivotal point in air force efficiency.

In evaluating the true importance of instrument landing it is necessary to consider it primarily as a schedule aid rather than a safety aid. With instrument landing aids the bad weather traffic capacity of an airport is tripled and becomes 12 landings per hour, the same as in good weather. Actual zero-zero conditions are fortunately rare and while instrument landing will permit flight operations in weather now considered unflyable, its primary contribution to safety in the air will be indirect through reduction of bad weather traffic congestion hazards at terminal airports.

This year will be the critical year in the evolution of a standard system which will be able equally to serve commercial airlines and military aircraft, landplanes and seaplanes. The selection of such a system will culminate more than 10 years of intensive research. Instrument landing originated in this country when, September 24, 1929, Lieut. James J. Doolittle made the first successful blind landing in history using a radio range localizer and his altimeter. Two years later, September 16, 1931, M. S. Boggs made the first blind landing on the U. S. Bureau of Standards system using a localizer to bring him to the field, a glide path to lead him down to the runway and two markers to check his position during the approach. This Bureau of Standards system was destined to become the prototype of the successful systems of today: The German Lorenz, French L. M. T., British Marconi, American Air-Track, Bendix and IT&T, and finally, the present C. A. A. system installed last year at the Indianapolis municipal airport.

(*Continued on page* 78)

The diagram below shows the complete CAA blind landing installation at Indianapolis. Note side view in the inset.



★ Plotting Ace ★

Teacher of navigation and shop mathematics, Commander Williams has charted the courses of many record flights you have read about in newspaper headlines during the past 10 years.

by JAMES BASSETT, Jr.

Someone asked young lawyer Clarence Williams about longitude in 1914 and launched him on a new career.

IN 1914 he didn't know the difference between latitude and longitude. For him, that was a sorry situation. He was a landlubber born to the sea—and he knew it. His grandfather was a Norwegian shipmaster and his paternal uncle a captain in the Royal British Navy during the War of 1812. So he resolved to do something about it.

As definitely and as casually as that, Lieutenant-Commander Clarence Strong (he prefers his middle name to be replaced by the mere initial "S") Williams started along the path that today has led him to a pre-eminent position among the aerial navigators of the United States. He is, he will admit freely, pretty much of an armchair airman.

His saga is that of a man who, although he can't fly a lick himself, doesn't hesitate to plot a 'round-the-world-course for somebody who can. His charts have helped experts span oceans, cross unknown continents, win races. And his "clients" are such famous persons as Capt. Dick Merrill of Eastern Airlines and 'round-trip to Europe renown; Col. Roscoe Turner, who flies around pylons faster than anyone else on earth; Jackie Cochran, the auburn-haired young woman who is the speediest girl in aeronautics. In the past he has served Amelia Earhart, Col. Art Goebel, Capt. Leland Andrews of American Airlines, Dorothy Kilgallen, the journalist; and Jimmie Haizlip.

Briefly, Lieutenant-Commander Williams, United States Naval Reserve, is a dark-haired, sharp-eyed, quiet-spoken chap who lives modestly in a little house littered with maps, graphs, charts, papers, and—sometimes—hardworking assistants. For when the Commander has a tough job at hand (such as turning out a set of maps for a transpacific flight in two weeks) he hires a batch of smart young meteorology and navigation graduates and starts 'em scribbling like Renaissance monks.

Right now Commander Williams engages himself with teaching navigation and shop mathematics to Maj. C. C. ("Mose") Moseley's 400-odd Army Air Corps cadets and mechanics at Curtiss-Wright Technical Institute in Glendale, Cal. For him, lecturing is nothing new; Southern California abounds with amateur yachtsmen and flyers who owe to him their skill at scoring a bull's-eye landfall or landing.

But mapping is his first love. In a war-like era when far-flying aircraft make erstwhile vast distances look like kiddy-kar treks, Commander Williams' specialty is liable to become something vastly more important than drawing pretty pictures on scratch pads. Men who, working with such tools as atlases, globes, calipers and long distance telephones, can decide for you the best route between two points 15,000 miles apart may yet become as valuable as front line generals.

Commander Williams sees distances in terms of "logistics"—the Army phrase for the science of establishing suitable supply bases—as well as in compass-readings, air-speeds, and the best flying altitudes. His experiences make a swell adventure yarn.

Back in 1914, when the tale begins, we find a young lawyer, newly admitted to the bar, writing to the War Department for a drill manual. He didn't know much about militaristics. But he did know that Europe, at war, was a menace to the United States. Thereafter on long winter evenings Williams (who wasn't a Navy officer then) sent the neighborhood kids through authentic drills.

About this time somebody asked Williams about latitude and longitude—*and he didn't know.* Blood will tell. This scion of generations of seafaring men locked himself in his office, pulled down the blinds, yanked a copy of Bowditch from a shelf—and found out. When he knew, he began teaching the townsfolks.

Then came war. As a lieutenant, junior grade, Williams helped man the convoy that escorted the first transport to France. Months later he helped ferry the shattered remnants of the fighting First Division back home. War ended, Williams qualified as first mate on a tramp steamer.

But with peace came Depression I. Newspapering wasn't much better than shipping. So in 1930, pretty well disgusted with mundane occupations, Commander Williams (he had by then earned his Reserve commission), entered navigation as a life's work. With 1930 came Col. Roscoe Turner, powder blue uniform and all, seeking data for a transcontinental record attempt. Commander Williams obliged. In turn, Turner, accompanied by his famed lion cub, smashed Frank Hawks' mark and brought reflected glory to the man who made his charts.

From that day forward, the Commander knew what he wanted—and got it. He received commissions to evolve maps for a goodly list of the world's

(*Continued on page* 89)

YANKEE WARPLANES OVER THERE

By
LEONARD ENGEL

American-made bombers and pursuit ships are doing well with the Allies but they lack gunpower and armor.

DESPITE an occasional politically-inspired blast in Britain's weekly contributions to aviation journalism, *Flight* and *The Aeroplane*, the English and French press has been reporting ecstatically on the American planes serving the Allies these days. All things considered, they say, the American ships are putting up a helluva show.

They are telling, however, only a minute part of the story of American aviation so far in World War II. Walk up to a mechanic at a Royal Air Force training station where North American *Harvards* are teaching embryo English fighter pilots the fine points of air combat and ask him what he thinks of the ships.

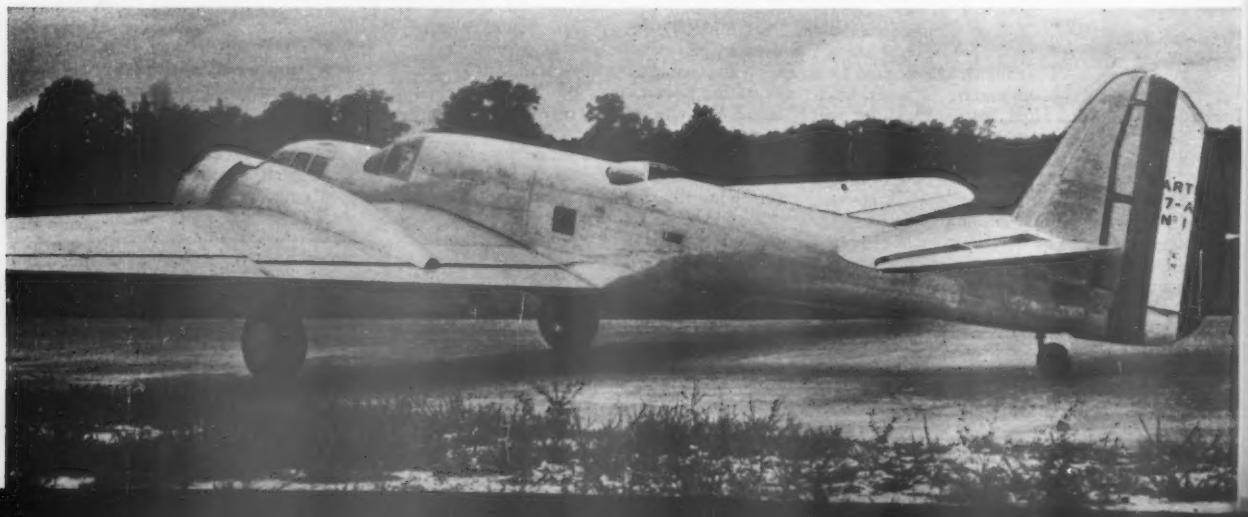
"Think of them?" he'll say. "I love 'em. Never seen such ships. Squirt in some grease and pump in some oil and, why, they run forever. No sir, we never got *that* kind of ruggedness from our own."

Query the 1,000-military-hour veteran French pilot with his inevitably slightly ill-fitting uniform. "Eh bien, mon camarade pilote! How do you like your Curtiss *Hawk?*"

"Why, marvelous of course," he answered as he shook his fist skyward in the general direction of Germany. "Ah, we can give it to him, le Boche, with these little machines."

North American's NA-16 (above), renamed the "Wirraway" by the Australians, is used as a general purpose plane and trainer.

Martin 167F bombers have made at least one successful flight over Germany for the R.A.F. France has lost but one of this type ship.



"Are they maneuverable, monsieur?" "But yes. And so rugged."

Seven types of American ships, five of which have already had extensive use, have been in Allied service for periods of between a few weeks and nearly a year. They are the P-36 with the French air force, the *Harvard* with the R. A. F. and the Royal Canadian Air Force for pilot training under the empire training program; a fixed-landing-gear, lower-powered North American of similar design: the NA-57 with the French; Douglas' first contribution to bombardment lightning, the 300 m.p.h. DB-7 delivered to French North Africa; the Martin 167F, export version of the Martin attack bomber; the Lockheed *Hudson* scout bomber of the R. A. F.'s North Sea patrol; and a single Consolidated 28-5, export version of the Navy's PBY, so successful that this six-year-old type has attracted Allied orders for $9,000,000 worth more. The Canadians also have *Hudsons* and Douglas B-18A's, rechristened *Digbys,* watching Canada's Atlantic coast for Nazi submarines that may never come. About 1,500 planes actually have been delivered to the Allies so far. Two-thirds are in England and France, the rest in Canada or Africa and the Near East.

All are showing Europe something European mechanics had only dreamed about before and held to be impossible: Trouble-free, tinkerless operation, ruggedness and staying power. POPULAR AVIATION's correspondent, for example, has seen nervy French student pilots take NA-57's off fields so rough you wouldn't drive a car over them at more than 20 m.p.h. The pilots didn't mind. The planes didn't either.

But America is not perfect. The war is demonstrating plenty of the fine points of air war and we ought to learn. Let's work up a balance sheet on American aviation so far in the second World War.

Curtiss' three-year-old P-36 in the hands of the French pilots, the war's wiliest, proved second only to the newer and faster Supermarine *Spitfire,* though it is not so maneuverable as the more lightly loaded Hawker *Hurricane.* It has shown only one really undesirable flying habit: violent vibration in a snap roll.

Part of the *Hawk's* success must be credited to its armament. Right here we come to one of those points on which Europe's war is the teacher and America ought to be the learner. French engineers started by installing four guns (one in each wing and two firing through the propeller disc) in the snub-nosed chaser. That is two better than American practice with the same plane even though one of the American guns is a .50 caliber. Lately the French were putting six rifle-caliber machine guns into newer *Hawks* powered with the *Twin Wasp C* instead of the *Twin Wasp B* (1,050 h.p. as against 950). The guns are installed in an unusual fashion—two or three pairs of selection switches in the cockpit allowed the French pilot to fire two, four or all six guns. In the British fighters it's all or none.

The war and the excellent showing of eight-gunned British *Spitfires* and *Hurricanes,* most heavily-armed single-seaters, is proof that heavy armament is as important aloft as on the ground and at sea. Germany's Messerschmitt single-seaters are also heavily armed; four machine guns with or without a 20 mm. heavy gun to boot. Everyone in Europe started this war anywhere from two to six guns up on the U. S. Army Air Corps. The Air Corps appears to be responding at last to the drumfire of reports of heavy European armament from its observers over there but what has been done should be no more than a starter. England has a 12-gunner coming along. America would do well to count its air guns by the dozen too, if a completely up-to-date air force is desired. When you are behind to begin with you generally have to do better and do far more than the opposition in order to catch up. That is the United States' situation today.

The Frenchmen had worked out a couple of neat tricks with the P-36. One is a 1940 switch on a stunt Von Richtofen used to pull with his weirdly maneuverable Fokker triplane in the last show. The French took advantage of the P-36's built-in headwind—it is the only radial-engined job in action. The French pilots went out looking for trouble and then proceeded to bait the trouble into chasing them. With the Nazis just out of gun reach and allowed to catch up slowly, the Curtiss pilots suddenly closed their throttles, climbing slightly. They lost 100 m.p.h. just like that—as fast as you can read these

Suffering a direct hit by anti-aircraft fire over Norway, this Lockheed "Hudson" of the R.A.F. returned to its base safely on one engine. Note shrapnel holes in fuselage.

Crew examine damage done to another ship. Originally built as a passenger airplane the "Hudson" is serving commendably for the British as a North Sea patrol scout bomber.

American engineers have perfected self-sealing gasoline tanks, similar to the armor protected ones used abroad. Thirty-two .30 caliber bullets failed to damage this tank.

words. The Nazis with their streamlined in-line engines were unable to duplicate the maneuver, and went scooting by beneath. Whereupon the French of course dove and let 'em have it. The Red Knight used to do that depending on his three wings instead of an engine to make that sharp turn up.

The French were getting about 320 m.p.h. from the P-36. Impossible? The catalogue says the plane is good for only 302. The catalogue never figured on French nerve or the ruggedness of American engines. The French were getting that extra speed, in spite of armor plate which the American-used ships do not have, by overrunning the engines for as long as they want the extra speed—nearly 3,000 r.p.m. for protracted periods. The *Twin Wasp C's* normal maximum take-off r.p.m. is 2,700. Bearings are being burned out by the bushel but the cylinder heads still stay on. Pratt and Whitney's engines like other American jobs have what it takes, even more than most of us had expected.

On top of this systematic abuse the engines are not getting quite adequate servicing. Engines never do in wartime. The P. & W. *Twin Wasp* radials are being run more than 300 hours between overhauls. British radials in the same power class do not do as well. The British Rolls Royce *Merlin*, though it is probably the most highly developed in-line power-plant, runs about 60 per cent as long (in-line engines so far all require more attention than the older radials). The best French motors in the same power class do about half as well as the Americans—another tribute to our engines over there which so far include *Whirlwinds, Wasp Juniors, Cyclones* and *Twin Wasps*.

Lockheed's converted passenger liner also astonishes the R. A. F. It is not a first-line bomber, was not designed as such and ordinarily is not used for such work, although some may have been so used in Norway. There are moments when one would feel that the British general staff is capable of almost anything. They are well liked on the North Sea patrol for their high performance for relatively low power output. In other words they are cheap to operate. The handling characteristics of the original Lockheed "14" design on which the *Hudson* is based had been criticized severely in the United States. British pilots find, however, that they are better flying machines than the only comparable British model, the Avro *Anson*. The *Hudson* is far more stable, carries much greater loads and has superior range. More Lockheed scout-bombers are to be ordered—surest proof of the pudding. These new ones, by the way, will be based on the faster *Lodestar*.

The *Harvard* is the best aerobat in England and therefore tremendously respected by student pilots. All but 100 of the *Harvards* so far delivered are in England; the others are in Canada. England has a faster advanced trainer in the Miles *Master* (271 m.p.h. as against 245) but a lot of people are finding out that speed is not the most important criterion of a trainer. The English do denounce the *Harvard* for one thing, however: its racket. With its direct-drive the *Harvard* sounds like a blitzkrieg as it takes off. But let's toss the ball right back to the Air Ministry in London where the blame for this situation should go. Direct drive was specified by the thrifty British Purchasing Commission. It's cheaper by a couple of hundred dollars a ship.

The lone Consolidated was flight-delivered to the R. A. F.'s Felixstowe experimental station last summer. It is a safe bet that the first real mass trans-Atlantic flight deliveries of American planes will be the shipments of additional 28-5's now on order when they start rolling out of Consolidated's assembly yard in San Diego this summer. The 28-5 has shown the British a thing or two. For this 14½-ton twin-engined flying boat has been found able to patrol a larger area than the highly-touted 23-ton four-engined Short *Sunderland*. For little more than half the original cost, half the operating cost, half the crew, the PBY does at least as much work. Four motors do not pay military flying boat dividends until the 30-ton size is reached. The PBY is a gentle hint that Short is building eight or nine tons more flying boat than necessary.

Little information on the Martins and Douglases is yet available, largely because they have not been in any action to speak of. But now that the blitzkrieg is really under way they are liable to have to go to work. These Martins made a scouting flight over Germany on at least one occasion. But one scouting expedition does not make an air war. According to the best available information to date, just one Martin 167F of the French air force has been wrecked. It was in an accident behind the front lines. The French pilot, inexperienced in the operation of a modern twin-engined American warplane, took his ship off with one propeller in high pitch and the other in low. Also, the pilot had neglected to turn on the gasoline switch on the engine turning the high-pitched propeller.

What of some of the things for America to learn besides more armament? One is that fighter pilots do not like sliding cowls. One bullet can jam the track. Getting out in a hurry through the emergency pane which can be knocked out takes time. In some ships such as the *Hurricane* a big man has a hard job getting through the emergency pane with a parachute. Leaving the emergency envelope behind is slightly impractical. The P-36 has a sliding cowl.

Important points for protection of the fighter pilot are the bottom, front and rear of the cockpit. The engine protects either front or rear (the rear only in such unorthodox ships as the P-39) in a single-engined ship. Engines protect nothing in the Lockheed P-38. Front and rear both are protected in such an unusual job as the tandem twin-engined Fokker D-23. That leaves other parts unprotected and they should be quarter-inch steel armor-plated. The French started systematic armoring with the P-36's and the habit is spreading elsewhere. Their armor is designed to stop rifle-caliber bullets; .50 caliber will penetrate it. Since everyone is going over to .50 caliber or better for that reason within the next year. American designers might consider urging the steel-makers to turn out quarter-inch armor capable of stopping .50's.

Airmen in Europe are universally critical of one American habit: Formation bombing. In Europe single approaches are most often used, for Europe has respect for the anti-aircraft gun and believes that the compact bombing formations one sees in U. S. Army Air Corps textbooks are the anti-aircraft gunner's dream. The fact that the "Archies", particularly Germany's 88 mm. weapon and the 40 mm. Swedish Bofors rapid-fire guns (used by Britain and Germany both), have come a long way since the World War I days when

(*Continued on page* 86)

SPORTER

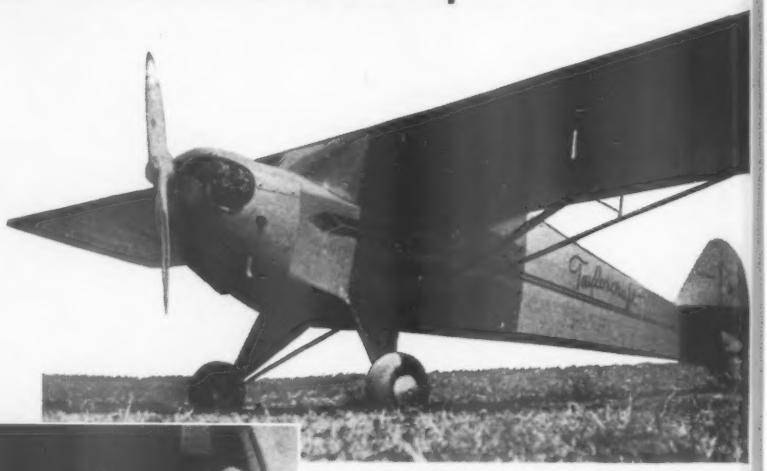
Coming up for a look at our camera plane,
this new Taylorcraft strikes an interesting pose.

ACROSS THE U.S. FOR $27.50

by

Robert Ewing

This young pilot decided to find out what flying conditions were outside Western New York. He learned the value of radio on a 5,600-mile trip.



A sheep ranch and a field beside a railroad track were visited by Ewing's Taylorcraft.

IF you ever have wanted to kick up your heels and do something you've been itching to do for a long time, you'll know how I felt when I spread out my maps on the kitchen floor back in Olean, N. Y. There they were, 14 section maps laid out in the darndest mess you've ever seen. They held the key to my biggest ambition and the answer to the question: "Can a guy like myself safely fly to California in the middle of winter?"

I took stock of myself. With my shoes on I could push up to five feet, six inches. I wore glasses to correct my vision for nearsightedness and astigmatism (the Doc had okayed me for a commercial rating, however). Added to this I was 23 years old and had been flying since July, 1938. Since that first introduction to a *Cub,* I had flown 168 hours and 30 minutes. My private license had been received a year from that first half hour of instruction.

When the news came that the lightplane cavalcade was off once more to Florida, I determined to go along and take a friend with me as passenger. As a later thought I had made up my mind to fly my Taylorcraft "50" to San Francisco and see what the flying was like beyond my backyard in western New York state.

Last March when the winds were blowing and snow still lingered on the ground, I had decided to build an airport with a friend. Without a ship, without all the money needed to buy one, I pitched in and we began fixing up a cow pasture landing field. Soon my friend's Aeronca C-3 was in our home-made hangar. At last my hangar was built in April and I made the trip to Alliance and sailed home in my red airplane. Our field was 2,700 feet in the wrong direction, in the prevailing direction of the wind—west—it extended a mere 400 feet. This merely made us work a little harder on our landings.

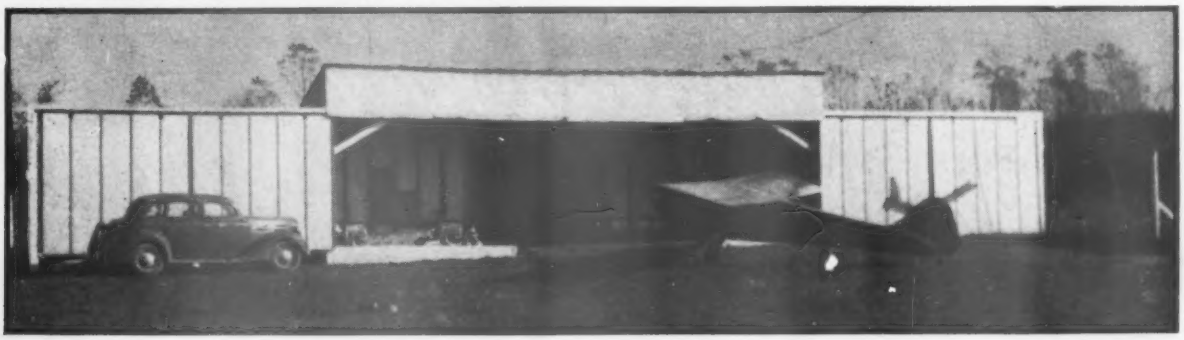
Bob Ewing is now with the United Air Lines traffic department office in San Francisco.

Through the summer we flew constantly and soon two more ships were hangared on the field. With the approach of winter our flying was sharply halted—it was California for me.

From this tiny field I at last took off on the morning of December 26. As my passenger I was carrying the wife of my friend, whose business reared its ugly head at the last minute and cancelled his trip. We joined the cavalcade in Cleveland and spent two days in the snow and fog that hovered over the municipal airport there. In the March issue of POPULAR AVIATION you read of a trip made down with this same wing to Miami—my experiences were similar to that author's. We were forced to land in Feesburg, O. at sunset in a blowing snowstorm. The forced landing went smoothly; we landed and took off next day in a small field that had plenty of soft deep snow.

It was smooth sailing after this—Nashville was an over-night stop and Lake City, Fla. was our stop on New Year's Eve. Finally we arrived in Miami and made a last gentle landing at Eastern Airport. Now we realized how easy the flight had been through strange country —and we knew that you and you too

With a friend, the author built an airport by leveling an Olean, N. Y., cow pasture and then constructing this hangar for $165.



could fly this trip without a DC-3 and a Scheduled Air Transport ticket in your hip pocket.

My friend met his flying wife in Miami and found her a woman well versed in the art of finding airports and sitting tight while the compass guided us through the haze over rough country to the next gas stop. Her presence on the trip had amazed women we had met and now she was an A-1 aviation salesman raving about our favorite pastime in true flyer's style.

When at last I left Miami alone on the morning of January 8 I wanted to find out just what the fellow is in for who plows across the country without that generous aid that the Gulf Oil Company gave us all the way to Miami. Without their representatives and trucks Johnny-on-the-spot in the small out-of-the-way fields—just how much difficulty would be found in getting gas and service for the tin-can tourist? When I pulled out I took stock of my equipment. The plane was full to the roof with baggage that left me little room to sit comfortably. On the vacant seat was piled a map case, typewriter and Lear portable radio. Somewhere under the mess of bags was a canvas sack containing homemade windshield and motor covers. Iron stakes and ropes were buried still further down. A flashlight, screwdriver, pliers, roll of safety wire, two rolls of cellophane tape made up my tool kit. With a $7 compass (10 years old), leading me westward, I now had 27 maps and the little portable radio to use for further navigation. The Lear was a bright idea that needed a little further thought. I had never flown with one, never read about the use of one, but had practiced on the beams from Erie, Pa., to Miami in only the most perfect contact weather. Thank heaven I knew just enough not to use it alone or without maximum visibility and ceilings. My ear had been educated to the beam while my eyes were fixed on the ground and my finger traced the course on the map in my lap.

Pulling out of Miami I opened a tiny lunch kit that had to set on the floor for want of space elsewhere in the ship. For my breakfast I had milk in the thermos bottle, a sandwich and chocolate bar in the tin box. Sailing over Palm Beach on one side, West Palm Beach on the other, the stabilizer held the ship to its course unaided while I breakfasted at 4,000 feet until Fort Pierce came into view. Never have I felt safer or more cozy at breakfast. The radio gave me the weather from both Miami and Jacksonville on this leg. Retracing my southward flight through Orlando, Ocala and Lake City, I enjoyed the view now that had been spoiled by rain and low skies on the way down. At last Tallahassee was my first night's stop out of Miami. Here genial Ivan Munroe and the Florida highway department fellows drove me about and gave me the opportunity to thank them for the splendid Florida airmaps that the highway department has issued for we tin-can flyers who visit that state.

From the cockpit of his plane Ewing took this picture of the Airway Traffic Control tower at Buffalo. It was his first stop on his trip from Olean to Miami.

The next night was spent in New Orleans, after flying over the pretty—but wet—sections that lie along the Gulf of Mexico through Florida and Alabama, Mississippi and Louisiana. I knew a little more now about the Alligator Club—when you find nothing under you but swampland and your eye is hugging the nearest railroad or highway, you begin to experience a feeling that suggests purple alligators and a lot more. Local pilots and operators had been fine about giving pointers as to compass headings, landmarks and safety-first precautions to be considered in this territory.

In De Funiak Springs I was forced to use the old reliable automobile gas from the gas station across from the field. In Mobile I landed by using my imagination to determine the wind direction. The sock was, and probably is, torn and tattered and wrapped around the pole many times. The beam was used from Mobile to New Orleans, maps and compass had brought me safely across from Tallahassee.

In New Orleans the N.A.A. convention was holding forth and we were treated to the sight of a *Cub* sitting in the lobby of the Roosevelt Hotel. It was a gathering of flyers from everywhere, sitting down to discuss the problems that will further the flying that you and I will be able to do much better as a result of their consideration of the problem carefully.

That ace seaplane flyer, Henry Chapman (see POPULAR AVIATION, December, 1939) gave me some hints on flying over

(*Continued on page* 68)

The goal of his 5,600-mile flight from Miami, San Francisco looked like this to Ewing completing his last leg from Bakersfield and Oakland with radio aid.

The Army's super-secret Sperry bomb sight should enable Boeing's "Flying Fortress" to ring up top scores in wartime use.

LOOK OUT BELOW!

by JAMES L. H. PECK

Aristocrats of the airpower family in World War II are the lethal bombers. Here's their genealogy, the missions they are designed for and how bomb sights line up the target.

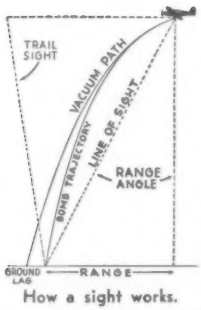
Ordnance officers check over a supply of "eggs" before the bombers are loaded up.

IT's open season over there. Bombers are goin' to town literally and colloquially over Scandinavia, the North Sea and France. While the "why" of the air raid seems immediately obvious, the actual bombing operation as apart from the strategy is not so generally understood.

The bomber family boasts an interesting genealogy. Long-range heavy bombers carry huge loads of "eggs" and fuel for great distances; our famous Boeing *Flying Fortresses* are shining examples. Medium bombers, such as the Heinkels and Dorniers now raiding the British Isles, are smaller and generally faster and carry less war load over shorter distances. Reconnaissance-bombers like the Lockheed *Hudson* are employed for long-range observation missions, but may bomb the enemy as well as tell on him. Our Navy's Consolidated PBY flying boats, now busy on neutrality patrol, are called patrol bombers. Their tactics are essentially the same as those of reconnaissance prototypes—find the enemy then smoke him out. Attack-bombers, strictly an American innovation, are the baby brothers of the family; having a 50 to 60-foot wing span and operating for the most part at treetop altitudes. These craft are as fast and maneuverable as some pursuit planes and are the most deadly things on wings.

Bombers supply the striking force of this thing called airpower. They are the fist of the air arm; pursuits, attack planes and attack-bombers are employed mainly to "run interference" for their big brothers by nullifying aerial and ground defenses that may jeoparidze the bomber mission. Somewhat contrary to the popular opinion, bombing planes do not cruise about the skies looking for trouble. They are dispatched upon specific missions. The method of bombing and type of "eggs" to be used are dic-

Some wartime objectives call for formation bombing like the salvo of 600-pounders being dropped by Army Air Corps Martin B-10's.



How a sight works.

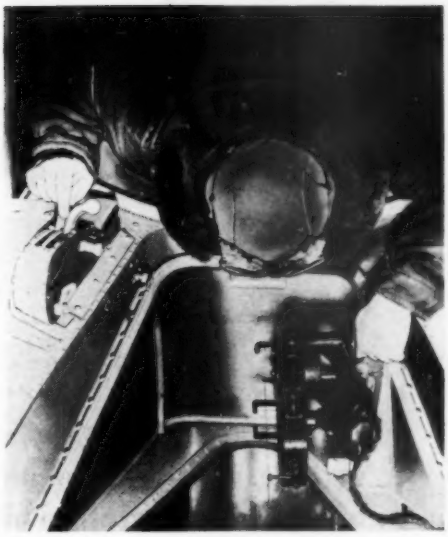
tated by the objective and its distance away determines what type of craft shall be employed.

"But how can the bombardment commander know in advance what he will do and how he will do it?" asks someone. There's a bit of a story to it. Wartime goings on demand expedient use of material and economy of a sort is a "must" for bombing squadron commanders. They dispatch no more planes and bombs than the number necessary to destroy or neutralize the objective—nor any less. To ascertain, with reasonable accuracy, the type and amount of bombs he must use, the commander consults complex tables and graphs known as probability charts, which have been computed and compiled by mathematical processes and analyses of the results of previous practical bombing.

Say, for example, that the objective the high command wants destroyed is a large aircraft plant. In military parlance, the objective is the general area (the aircraft factory) and the target is the specific object against which firepower is directed (each of the factory buildings, hangars or the adjacent airdrome). One certain chart will advise the commander that a brick and concrete outfit like that under consideration should be destroyed by 10 1,000-pounders. But the law of averages and technical difficulties dictate that the squadron must drop *more* than the 10 required bombs to even *partly* assure that number of hits. How many more will be needed?

Because the expedition involves only three hours' flying time medium-bombers will be used. The poor strategy attend-

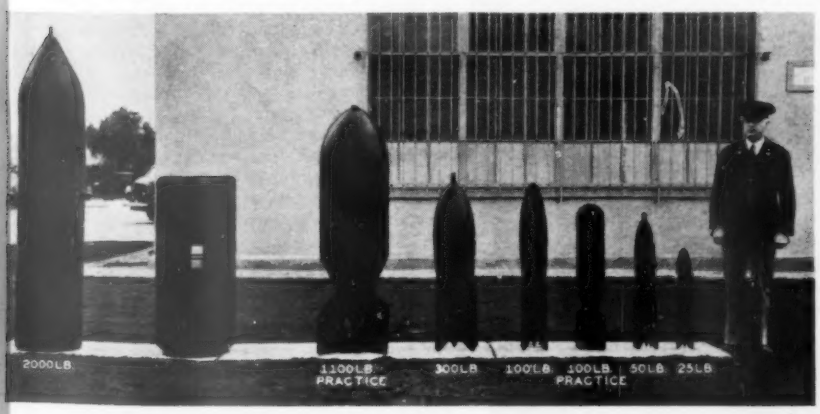
(*Continued on page 70*)



Right hand on bomb release, bombardier lies on his stomach while adjusting the sight.

In the nose of an R.A.F. bomber, the sight computes range, wind drift and ground lag.

Bombs range in size from midget 25-pounders to giant demolition "eggs" of 2,000 pounds.



Latest airline safety feature is this new Boeing "Stratoliner" for over-weather flying.

The Airlines PROVE THEMSELVES

by CLARENCE MACK

Three years of determined effort brought to commercial aviation the best safety record of any transportation medium. Government, manufacturers, operators share the credit.

Airways Traffic Control keeps a keen watch on weather and traffic conditions at fields.

YOU probably remember the story. From all appearances it was just a dull and tarnished lamp of no apparent value. But when by chance the secret was discovered its possessor had but to command for all wishes to be granted. For Aladdin the results indeed were miraculous. Like Aladdin the nation's commercial airlines now possess such a lamp —a year's perfect safety record. From March 26, 1939, to the present time they have flown all schedules without a single accident involving a fatality or serious injury. In addition while making this record they have flown more schedules, carried more passengers, mail and express and at greater speeds than in any previous 12-month period since their existence. Passenger business alone increased by 50 per cent. Never before has such a safety record been achieved by any medium of transportation. Already the results promise to be astounding.

In former years airline safety records, although good, were nothing to brag about. Lean years of fierce competition had relegated the achievement of greater safety to the realm of wishful thinking. Since the disastrous winter of 1936 however the trend perforce has been different. Since then three years of hard and careful work have been spent burnishing the lamp of safety.

Contrary to what might be offhand impression the present standard of airline safety was not a matter of easy achievement or luck, but rather the combined results of determined effort of all airline operators, governmental agencies

Airline pilots study weather maps and get a full report on all conditions over their route before starting a scheduled flight.

Although graduates of the Army, Navy and commercial schools, airline pilots still attend classes that include Link training.

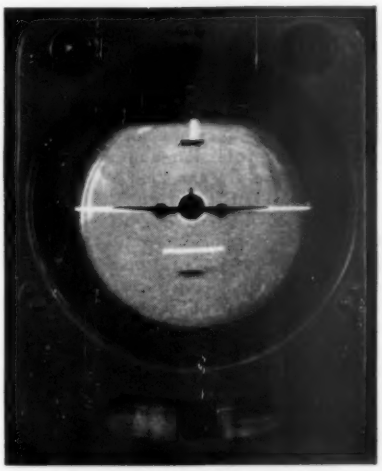
and manufacturers of airline equipment. Undoubtedly never before in the history of commercial aviation has there been witnessed such a unified effort for a common goal. Many diverse and complicated problems had to be clearly recognized and a solution effected.

FLIGHT PERSONNEL: Without question the most important single item in the safety factor of any flight is the proficiency of the men who fly the ship. As airline pilots they form a select group, a mere 1,500 men responsible for the tens of thousands of miles flown daily over the nation's airways. Like other airline problems that of pilot standards has been one requiring many years of transition from the old-time carefree and untrained barnstormer to the modern master of flight. At one time the airlines had no specific standards for their flight personnel. Pilots were hired and fired at random, paid and ill-paid, unsupervised and often overworked. As a result it gradually became apparent that more comprehensive regulation for airline pilots was necessary. The pilots themselves demanded it; the government soon realized the necessity of forcing it; the airline operators belatedly welcomed it.

The first decisive step in this direction came as the result of a pilot strike on one of the minor airlines which led to the formation of the Airline Pilots Association. Thereafter acting as a unified group the airline pilots have constantly worked not only for the betterment of themselves as pilots, but for the advancement of sound safety regulations and operating policies. What first promised to be just another union has proved to be an unexpected stroke of good fortune for the airline operators in raising pilot regulations and standards of proficiency to a level that now excludes all but the very best. No longer is it possible for the inexperienced to be hired in the interests of economy. Hundreds of hours of training and flight experience are necessary for consideration of even a co-pilot's position. Thereafter two to three years of additional training are required before assuming full responsibility as first pilot. The government contributes its safeguard by requiring a minimum of 1,200 flying hours for certification as a first pilot (only 200 hours are required of a commercial pilot). The maintenance of instrument flying proficiency is guaranteed not only by intensive company training, but by formal 90-day check flights. Route qualifications are regulated severely. Physical fitness is guaranteed by comprehensive examination each three months (twice as often as for the non-airline pilot).

In addition working hours are planned carefully. A maximum of 85 hours a month is permitted with further specific regulation regarding maximum hours per day and maximum hours per week with compulsory rest periods between each of a pilot's flights.

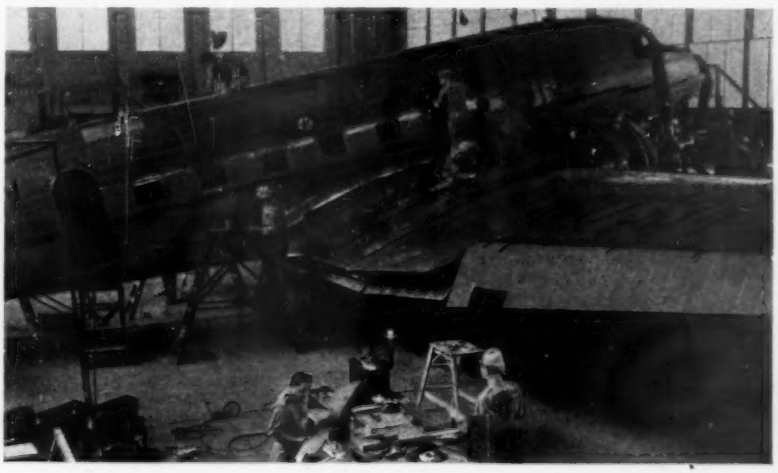
Unquestionably higher standards of proficiency and more careful regulation have been of inestimable value in reduc-

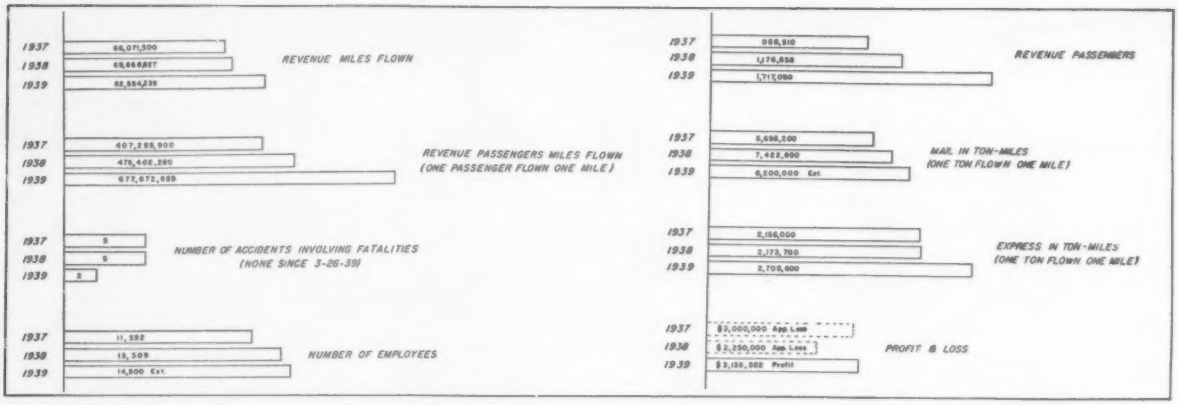


Flightray, new safety guide, combines the bank and turn indicators, directional gyro.

★

Mechanics complete a major overhaul on a Douglas DC-3. Periodic checks and overhauls of each part of the ship prevent failures aloft, maintain it in its best condition.





Increased safety means more business, both in number of passengers and amount of express carried, as shown graphically.

ing the liability of pilot error. Another contribution has been to raise the general standards of the men selected for airline pilots. The operating companies realize that only the highest type of man can become a good investment. Choice therefore is careful. Army and Navy trained men are favored for new recruits. Educational requirements have rapidly tended to eliminate the unintelligent and untrainable. Considering all this improvement the present airline pilot is tops in his profession and all portents for the future are excellent.

SOUND OPERATING POLICIES: The era of modern operation can be dated from the spring of 1934 when as a result of the political fiasco in cancelling all airmail contracts an entirely new airline system came into being. Confusion was rampant. A new and punitive air mail act resulted in near bankruptcy for the older and established companies and guaranteed economic distress for the many new companies which had formed when the entire airmail system was opened for competitive bidding. Lack of profitable mail contracts, the general business depression and numerous inexperienced operators combined to produce a potentially disastrous situation. Other factors hastened it. In these years technical improvement of airline flying equipment (in particular increased operating speed and range) outstripped the ability of the industry to progress at the same pace. Simultaneously government laxity was allowing a far-flung system of airway aids to navigation to become obsolete.

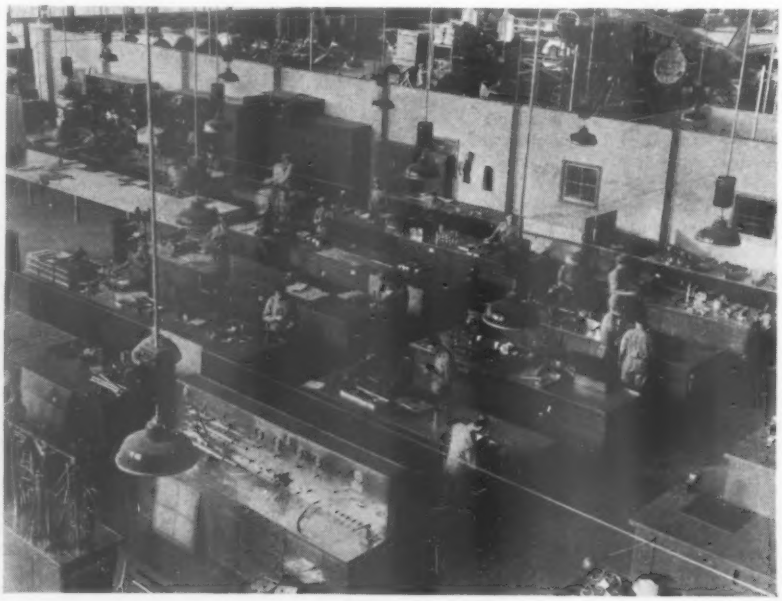
All these factors contributed to the disasterous winter of 1936-37 when an unfortunate and unparalleled series of accidents shook the confidence of the public and served notice to the airline operators that drastic measures were necessary.

Cooperative effort superseded cut-throat competition. Three general spheres of activity were initiated. First, all airline operators and the Pilots Association combined to petition the government for more comprehensive and sensible legislation and regulation. Extreme pressure was brought to bear on the government for a complete revamping of the federal airways system of navigational aids and a better system of weather reporting stations. The first of these efforts resulted in the creation of the Civil Aeronautics Authority to replace the former politically-controlled Bureau of Air Commerce. By this move the airlines as well as the aviation industry as a whole were freed early in 1938 from the whims of politicians and practical politics. The results unquestionably have been beneficial. Since 1937 the second objective of improving the governmental airway aids and expanding the weather reporting system has also been achieved.

A second sphere of cooperation has been between the airlines themselves. Recognizing the inevitable slowness of federal action, they immediately initiated numerous safety agreements for the regulation of airline traffic over congested areas and the dispatching of aircraft under adverse weather conditions. By clear-cut agreements between themselves

(*Continued on page* 64)

Flight on one engine is safer with the full-feathering propeller, now generally used.



Complete overhaul shops, where airliners go every 5,000 hrs., check all ship parts.

Roy McGuire, testing the new robot in his Monocoupe, forced the plane into a spin, let the robot bring it out in half a turn.

Little Robot

by RICHARD MARTIN

Boasting simplicity of operation and a weight of but five pounds, this automatic pilot now being perfected for lightplanes is expected to sell at less than $300.

THE SCENE: A lightplane factory. THE TIME: Two years or perhaps just one year hence.

As the tiny planes come sliding off the assembly line in apple pie order into the instrument department the foreman looks at a check sheet and bawls to the installation crew:

"Numbers 3, 5, 6, 7 and 9 get automatic pilots."

The men go to work at once installing the instruments.

Fantastic, you say?

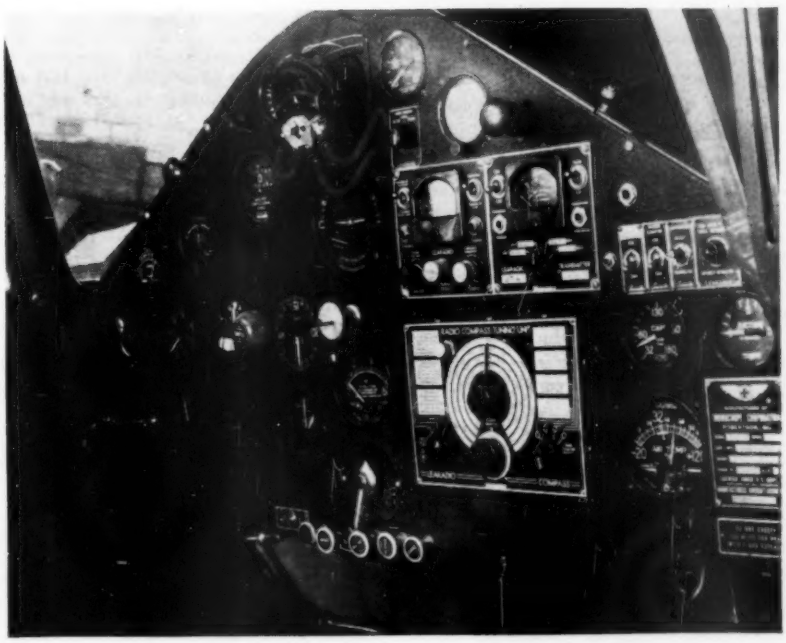
Not at all, for Roy McGuire has his Monocoupe equipped with an automatic pilot that has received Civil Aeronautics Authority approval and is destined to solve many of the problems of the lightplane owner. An important feature to the flivver owner is the robot's solution of the weight problem.

This new device weighs but five pounds with all the trimmings and is expected to sell for considerably less than $300. Full patents have been granted on the device.

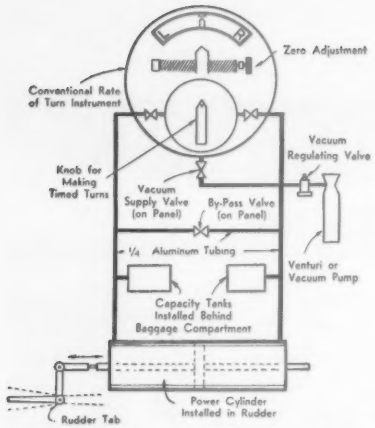
The automatic pilot eliminates the two greatest shortcomings of the present conventional automatic pilot for the lightplane owner—high cost and great relative weight. It isn't in commercial production yet, but will be in the near future, the manufacturers of the device say.

POPULAR AVIATION'S correspondent made an hour's flight in the Monocoupe of Roy McGuire recently when he stopped briefly in Amarillo, Texas. At that time McGuire was a traveling representative of the DeFlorez Company and had put hundreds of hours on the robot during its test period.

Since then McGuire has joined the staff of the Lear Avia, Inc. at Dayton, Ohio, also in a traveling capacity as manager of the southern and western division. Lear Avia, Inc. are manufacturers of Learadio and direction finders. However, he has left the pilot-equipped Monocoupe at the factory for further development of the robot.



Using a radio compass, the robot steers plane to any station which is tuned in.


Zero Adjustment
Conventional Rate of Turn Instrument
Vacuum Regulating Valve
Knob for Making Timed Turns
Vacuum Supply Valve (on Panel)
By-Pass Valve (on Panel)
¼ Aluminum Tubing
Venturi or Vacuum Pump
Capacity Tanks Installed Behind Baggage Compartment
Power Cylinder Installed in Rudder
Rudder Tab

Robot is based on turn and bank indicator.

The instrument is built around the operation of a conventional turn and bank indicator from which the ball bank has been removed. The glass face has been replaced by a small rotary valve which is operated by the pointer of the turn indicator. Action of the turn indicator directs a vacuum supply, either venturi or vacuum pump actuated, to a piston installed in the lower part of the rudder. The turn indicator operates this power piston which in turn is connected to a tab on the rudder. In the case of the Monocoupe it has an area of about 30 square inches.

Operation of the robot is simplicity itself. The man at the controls merely sets the course after take-off. Any tendency on the part of the plane to deviate from this set course in counteracted by operation of the turn indicator which works on the trimming tab through the power cylinder, automatically swinging the ship back on course from its right or left deviation.

The robot is mounted on the control panel at an angle of 35° to the vertical plane permitting immediate correction for the sudden dropping of a wing in extremely gusty air. As the air was particularly bumpy during the Amarillo flight, due both to thermal currents and barometric conditions, the little pilot got a good workout and never failed to correct immediately for loss of horizontal wing attitude.

Any experienced pilot knows that opposite rudder will "pick up" a dropping wing. This is just exactly what the automatic pilot does in this situation through operation of the trimming tab.

Mounted at an angle the instrument is capable of correcting the attitude of the plane in two axes, lateral and directional. McGuire pointed out that if the robot were placed on the panel in the conventional manner the ordinary action of the turn indicator would make lateral control impossible. In a ship of the Monocoupe's size the 30 square inches of tab seemed adequate to keep the plane lined up without a perceptible yawing as the robot operates from the turn indicator.

Variation did not exceed one and a half degrees either way after a short 30-second adjustment McGuire made when the plane had reached cruising altitude. A close check on this accuracy was possible by flying hands off for several minutes and watching the directional gyro. McGuire said that this high accuracy made the instrument fully reliable for directional control on even the most difficult of instrument take-offs.

It is possible to force the plane off course by manual operation of the controls, but the moment pressure is relaxed the robot takes over again, corrects for the manually-induced error and puts the ship back on course. In timed turns the device performed much more accurately and smoothly than human hands. Despite the gusts, after McGuire had adjusted the small rotary valve we found ourselves making timed turns up to the rate of one 360° turn in two minutes.

Many private flyers have lost their lives because they got into a spin in muggy weather and were not conscious of it until they came tumbling down through the overcast to crash.

The robot was put into operation and Roy suggested the plane be put into a spin. It took considerable pressure on the controls to overcome the mechanical brain of the automatic pilot, but finally the plane went into a spin. With hands off the controls after two and a half turns, the automatic pilot went right to work, stopped the spin after half a turn and returned the plane to level flight as soon as sufficient flying speed had been built up.

This ability of the robot to prevent and to overcome spins is enough alone to make it worth many times its purchase price to the private flyer who makes many cross-country flights. Even should he get into difficulty during bad weather he has the assurance that the automatic pilot will get him out of it if he will just release the controls.

Over three years in the experimental stage, this new device has been given over 2,000 hours careful check.

McGuire feels sure the device can be built and installed in any conventional airplane for less than $300. He said an adaptation of the automatic pilot for use with existing radio compasses or direction finders is being developed. This device will permit automatic steering of the plane to any broadcasting station which has been tuned in.

Reference to the accompanying diagram will simplify details of the robot which is set in operation merely by opening the vacuum valve thus permitting the vacuum supply free passage to the instrument. The ship then is placed manually on any desired course and the operation is completed by closing the by-pass valve between the two flexible lines leading to the tab-activating power cylinder. The vacuum supply to the instrument is regulated by a small valve on the line leading to the venturi or vacuum pump. By means of this valve the flight characteristics can be regulated for either smooth or rough air.

END

Course deviation actuates turn indicator which works trimming tab placed on rudder.

Pigeons and Bombs

THE Army Air Corps has received an idea for effective high altitude bombing against warships, which it definitely will *not* use. The bomb, wrote the inventor, is slowed down by a small parachute. To the bomb is attached a pigeon and a rudder. As the bomb falls the pigeon "finds itself in the same predicament as any other tired bird crossing the ocean—and the instinct of self-preservation" forces it to struggle to alight on the ship. The struggling controls the rudder and the eventual landing insures a direct hit "each and every time." The inventor suggested that the parachute on the pigeon-towed bomb might be replaced with a windshield for the bird.

Swedish Student

AN old catalogue that found its way to Germany has brought a student from Sweden to the Ryan School of Aeronautics at San Diego, Cal. Seven years ago an American transport pilot sent a copy of the Ryan catalogue to a nephew. Four years later the nephew, leaving a German aviation school, tossed the old catalog aside. His roommate, Lennart Thorell, picked it up and made up his mind to go to the school. Thorell, a Swede, worked his way from his home to the United States as a dining room steward on a Swedish-American liner. Twenty years old, he is enrolled in the 176-hour commercial flying course. The day he applied for his first citizenship papers he would have been called up for military service had he remained in Sweden.

Build New Barracks

NEW BARRACKS with individual rooms are being erected at a cost of $20,000 by Curtiss-Wright Technical Institute, Glendale, Cal., for Army Air Corps enlisted men in training as aviation mechanics. The Army has 400 men in training at the school. There are over 1,000 other students enrolled.

Arlene Davis and her Spartan which she flew to fifth place in the 1939 Bendix race.

The SKY'S HER LIMIT

by

GEORGE R. REISS

About the only thing this persistent woman is not qualified to pilot is a trans-oceanic Clipper. She's flown lightplanes, transports and Bendix racers.

IF it's a story of persistence—grim, unflagging, determined, bull-dogged persistence—you want, take the story of little Arlene Davis of Cleveland. She's America's outstanding—and perhaps America's only—woman "big ship" pilot. She has been qualified to fly almost everything from a 37 h.p. *Cub* to a 2,400 h.p Douglas DC-3, a twin-engined Sikorsky or Consolidated flying boat—everything short of the tremendous trans-oceanic Clippers. The lady holds more different and difficult kinds of ratings than any other woman pilot and more than 99 out of 100 men commercial pilots—a commercial certificate with instrument, Class 1, 2S, 3S, and 4M land and water ratings—which, you'd think, would be laurels enough for one tiny, very effeminate young aviatrix. But not for Arlene Davis. She's also a racing pilot of some note, a money winner in the last Bendix Trophy Race and probably a contender in the next one.

It's all the result of her persistence, her dogged stick-to-itiveness, her refusal to give up which has kept her digging persistently into aviation text books. It has kept her plugging and droning on monotonously in the air, practicing landings, figure-eights, 720's, stalls and what-not, or climbing high into the blue in a Beechcraft, Spartan, tri-motored Ford or a twin-engined Sikorsky S-38, while the women of her Cleveland set spent their time at bridge-teas, garden parties or matinees.

Arlene Davis is the wife of M. T. Davis, president of the M. T. Davis Packing Company of Cleveland and well-to-do sportsman pilot, whom she married when she was a 16-year-old art student studying in the Chicago and Cleveland schools of art.

The story of how she learned to fly nine years ago is an amusing one. Her husband came home one day and, expecting to bowl her over with the news, announced laconically:

"I've just bought an airplane."

"That's nice," she replied in a matter-of-fact tone of voice with as much enthusiasm as if he had announced he had bought a new shirt. Davis had bought a Stinson and had engaged Major J. D. Barnhill, Cleveland National Guard officer, to teach him to fly.

Apparently—at least so far as Davis could see—Mrs. Davis just wasn't interested in flying. But, unbeknown to her husband, she too sneaked out to Cleveland airport and engaged Major Barnhill to teach her to fly, pledging him to secrecy. Having more time on her hands than her busy husband, she made rapid progress, soloing before he did.

One day, she accompanied Davis to the airport where he sought to show her the safety of flying, the progress he had made.

"Shucks," she said, with a deprecating air, "nothing to this flying business. Anyone can fly."

"Sure, there is," brustled Davis. "It takes skill."

"Why even I could fly," she challenged.

"You . . ." he laughed derisively.

Whereupon, she climbed confidently into the ship, took it up alone, brought it back to a perfect landing before her bulging-eyed husband.

"See how easy it is?" she inquired as she crawled out of the ship before her amazed husband. He hasn't been surprised at anything since.

With only two hours' solo time, she had another experience—a harrowing experience this time—which might have discouraged other less persistent flyers. While practicing landings on Cleveland airport one day a heavy lake fog—one of those sudden fogs which sometimes roll in without much warning from Lake Erie—blanketed the airport while she was in the air. The green student was bewildered by this sudden turn of events.

(*Continued on page* 82)

FLYING on the GROUND

by LIEUT. ROBERT J. BRUTON

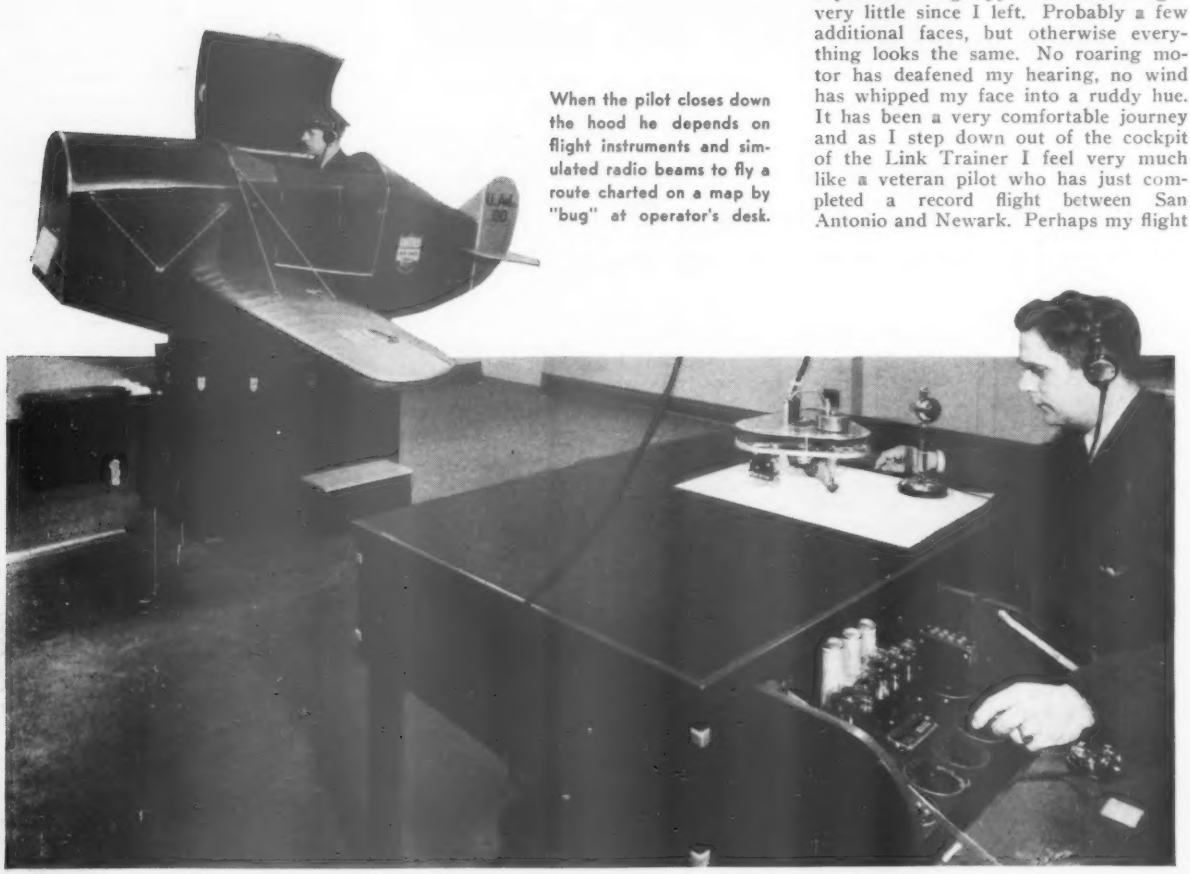
Pilots are learning to fly with instruments as their only guide and finding another hurdle over bad weather through practice sessions in the Link Trainer which is able to simulate all flight conditions in rooms at zero altitude.

Lieutenant Bruton

ON instruments at 5,000 feet. Quite an unpleasant predicament for a young pilot to be in. However, the radio reception is excellent and the beam signal is coming in very clear. A quick glance in the cockpit shows everything to be in order: Airspeed 160 m.p.h., rate of climb zero, tachometer reading 1,850 r.p.m. and compass course due east. I look down at the map to check my position. I have just passed over the Bellefonte cone of silence and I'm heading out on the eastern leg of that beam. If I am able to hold a true course, I hope eventually to contact the southwest leg of the Newark beam.

In five minutes Bellefonte fades out entirely. There is silence. I hold my course and soon I begin to pick up a faint "A" signal. It gradually builds up and after about a minute I begin to hear the "on course" signal in the background. As the "on course" signal grows in intensity I start my turn to the left, checking with my map for the new course. Soon I'm on the Newark beam, flying it in to the cone of silence. Suddenly the signal cuts out and through my earphones I hear someone say, "O.K. Raise the hood."

I raise the hood and look around. My surroundings appear to have changed very little since I left. Probably a few additional faces, but otherwise everything looks the same. No roaring motor has deafened my hearing, no wind has whipped my face into a ruddy hue. It has been a very comfortable journey and as I step down out of the cockpit of the Link Trainer I feel very much like a veteran pilot who has just completed a record flight between San Antonio and Newark. Perhaps my flight



When the pilot closes down the hood he depends on flight instruments and simulated radio beams to fly a route charted on a map by "bug" at operator's desk.

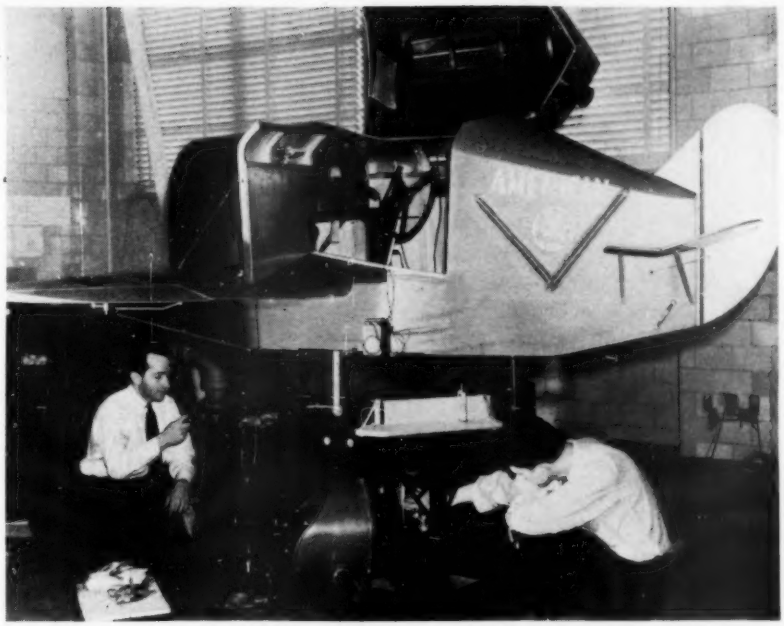
may never make a newspaper headline, but I have set some sort of a record. In approximately 50 minutes I have flown on instruments over almost half of the country. In my flight I have used practically every beam between San Antonio and Newark and if you doubt my word, let me show you my proof here on the table. This grotesque looking bit of apparatus is called a "recorder" or a "bug" by people more familiar with the equipment of a Link Trainer. It sits on top of a map, the same type of map that I am using in the cockpit, and it records faithfully on that map every move that I make in the Link Trainer.

It shows by means of a red line my flight path across the country. On closer inspection you can see that at Indianapolis I missed the cone of silence and consequently I was forced to reorient myself before I could continue on the beam. At Akron I experienced rough air. That condition is indicated by the wavy red line of my flight path. It is a very simple matter to reproduce rough air conditions in the Link Trainer by manipulating several valves.

Although you cannot discover it from the evidence on the table, I ran into severe icing conditions at Pittsburgh. My airspeed began to fall and I was forced down to 2,000 feet before it would pick up again. In addition I was handicapped by a cross wind during most of my flight. These are but some of the many weather phenomena that can be reproduced in the Link Trainer. So you see that although I never left the ground I experienced a few of the weather conditions that I might have run into had I made the actual flight.

But let us digress from the subject of this cross-country flight for just a moment. Let us go back to the summer of 1937. We are sitting in the rear cockpit of a BT-2 with an instructor who is trying to teach a student the intricacies of instrument flying. The student is not very proficient in this particular branch of flying. Time and again he makes the same mistakes and we see that the instructor is rapidly losing all vestige of patience. Repeatedly the student is warned that he is permitting the ball to slide down on the low side in each of his turns. Such advice seems to have little effect on the student as he continues to make the same mistake. Finally, in despair, the pair return to Kelly Field. For the next half hour the instructor attempts to explain to the student with the aid of some chalk and a blackboard just how he can correct this particular mistake and other mistakes that he has been making in previous flights. The student nods his head in assent indicating that he understands the situation thoroughly. But we can see by the expression on his face that the whole business of instrument flying is still one huge nightmare to him.

It becomes apparent that some method was needed, some advice was necessary so that the student could be taught the principles of instrument flying in a practical sense right on the ground. An instructor could spend many hours explaining to a student just what a one needle-width turn should look like on the instrument panel, but he is not able to get that idea over quite as well as he would if he were able to have the student actually perform that maneuver on the ground.



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After three hours of training at Ran-

Behind the Link's sensitive controls, pilots are faced by a standard instrument panel.

FLYING on the GROUND

by LIEUT. ROBERT J. BRUTON

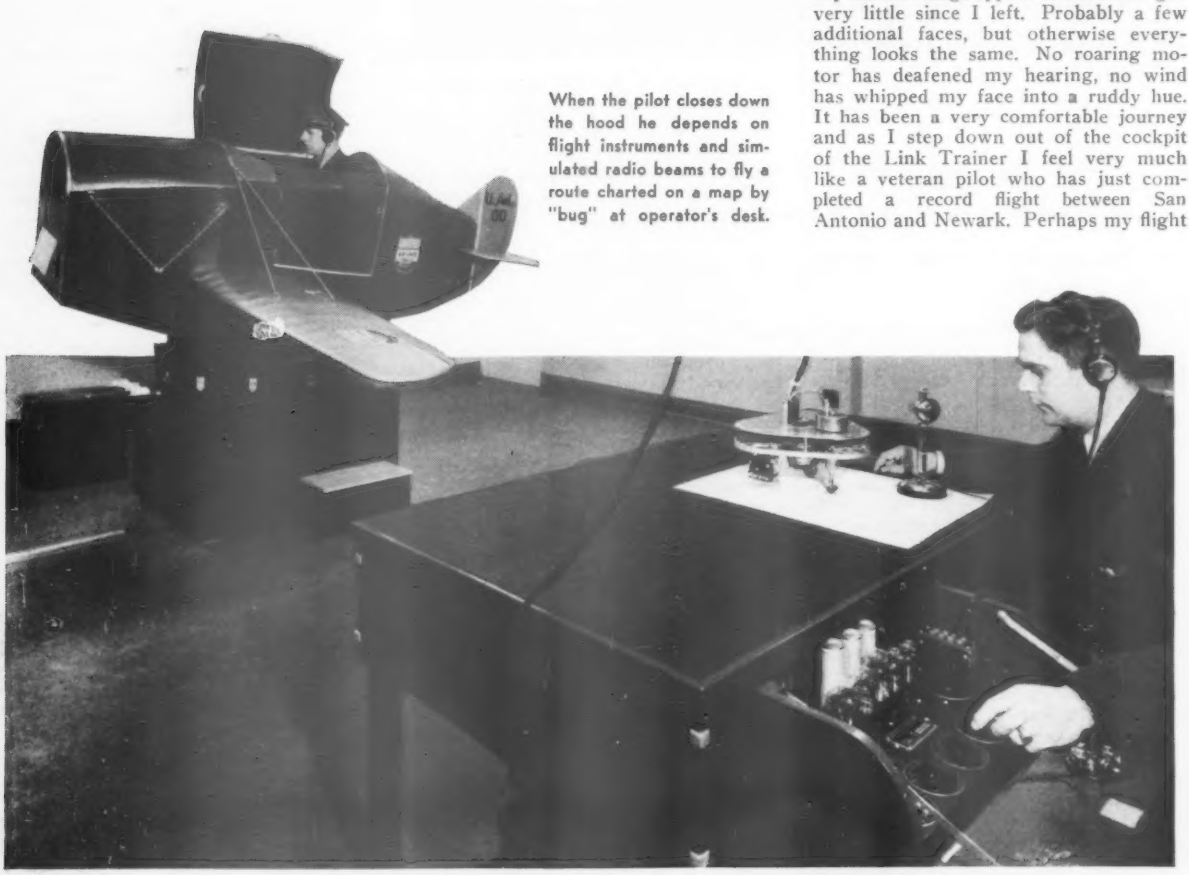
Pilots are learning to fly with instruments as their only guide and finding another hurdle over bad weather through practice sessions in the Link Trainer which is able to simulate all flight conditions in rooms at zero altitude.

Lieutenant Bruton

ON instruments at 5,000 feet. Quite an unpleasant predicament for a young pilot to be in. However, the radio reception is excellent and the beam signal is coming in very clear. A quick glance in the cockpit shows everything to be in order: Airspeed 160 m.p.h., rate of climb zero, tachometer reading 1,850 r.p.m. and compass course due east. I look down at the map to check my position. I have just passed over the Bellefonte cone of silence and I'm heading out on the eastern leg of that beam. If I am able to hold a true course, I hope eventually to contact the southwest leg of the Newark beam.

In five minutes Bellefonte fades out entirely. There is silence. I hold my course and soon I begin to pick up a faint "A" signal. It gradually builds up and after about a minute I begin to hear the "on course" signal in the background. As the "on course" signal grows in intensity I start my turn to the left, checking with my map for the new course. Soon I'm on the Newark beam, flying it in to the cone of silence. Suddenly the signal cuts out and through my earphones I hear someone say, "O.K. Raise the hood."

I raise the hood and look around. My surroundings appear to have changed very little since I left. Probably a few additional faces, but otherwise everything looks the same. No roaring motor has deafened my hearing, no wind has whipped my face into a ruddy hue. It has been a very comfortable journey and as I step down out of the cockpit of the Link Trainer I feel very much like a veteran pilot who has just completed a record flight between San Antonio and Newark. Perhaps my flight



When the pilot closes down the hood he depends on flight instruments and simulated radio beams to fly a route charted on a map by "bug" at operator's desk.

may never make a newspaper headline, but I have set some sort of a record. In approximately 50 minutes I have flown on instruments over almost half of the country. In my flight I have used practically every beam between San Antonio and Newark and if you doubt my word, let me show you my proof here on the table. This grotesque looking bit of apparatus is called a "recorder" or a "bug" by people more familiar with the equipment of a Link Trainer. It sits on top of a map, the same type of map that I am using in the cockpit, and it records faithfully on that map every move that I make in the Link Trainer.

It shows by means of a red line my flight path across the country. On closer inspection you can see that at Indianapolis I missed the cone of silence and consequently I was forced to reorient myself before I could continue on the beam. At Akron I experienced rough air. That condition is indicated by the wavy red line of my flight path. It is a very simple matter to reproduce rough air conditions in the Link Trainer by manipulating several valves.

Although you cannot discover it from the evidence on the table, I ran into severe icing conditions at Pittsburgh. My airspeed began to fall and I was forced down to 2,000 feet before it would pick up again. In addition I was handicapped by a cross wind during most of my flight. These are but some of the many weather phenomena that can be reproduced in the Link Trainer. So you see that although I never left the ground I experienced a few of the weather conditions that I might have run into had I made the actual flight.

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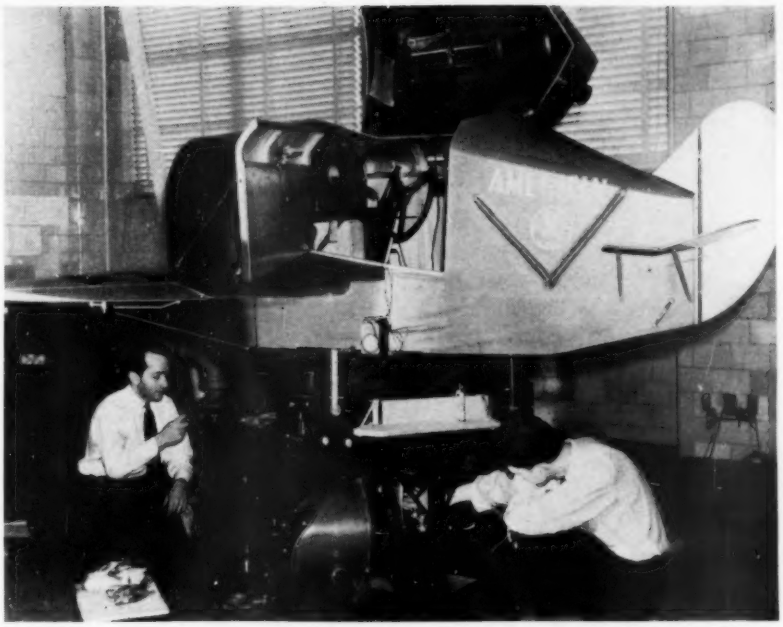

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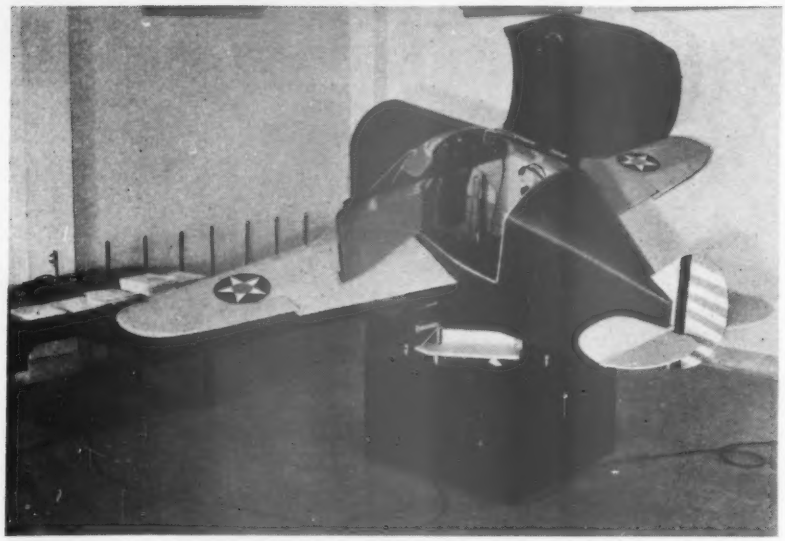


Army Air Corps student pilots at Randolph and Kelly Fields must take six hours in the Link on instruments before the "A" and "N" radio beam mixer is added to his training.

dolph Field, combined with some actual instrument flying, the student arrives at Kelly Field. He has had what you might call a taste of trainer flying and perhaps he does not like it. One reason for this dislike may be that he has grown tired of the monotonous routine of doing banks and turns under the darkened hood of the "Jeep". Undoubtedly he is anxious to get on with the more advanced phases of the work. At Kelly Field he takes up where he left off at Randolph Field. Banks and turns, climbs and glides and straight and level flying are still the order of the day with special emphasis being placed upon the accuracy and finesse with which the student does his work. Perhaps after two or three hours of such practice he is able to fly the Link Trainer to the satisfaction of the instructors. Then he is allowed to proceed to radio work. You might ask why is so much stress placed upon the fundamentals of flying when the student has already had over seven months of flying. The reason for this stress upon the fundamentals of flying is the airplane eventually will become a secondary matter and he consequently will be able to devote all his time and attention to the radio beam.

A standard part of the complicated equipment of the Link Trainer is an apparatus called an "A" and "N" mixer. This device faithfully reproduces in the trainer cockpit the familiar "A" and "N" signal, the "on course" signal, the twilight zone signals and even a cone of silence. The mixer also has the advantage of being able to reproduce any beam complete with the identification signals. So you can see how it is possible to take an instrument cross-country flight.

But let us continue with the flying instruction of our student. He is gradually introduced into each step of beam flying. First he learns how to identify the various signals. Next he learns how to orient himself when placed in any of the four quadrants of a radio range beacon. He is taught several methods of orientation and under what set of conditions each method is most applicable. This will include beam bracketing, the Stark method of orientation and a close-in procedure. Finally he learns how to fly the beam into the cone of silence. For every hour that the student spends in the Link Trainer he spends an hour and a half in an airplane. The basic idea behind this sequence of events is, first, the student learns how to perform a particular mission in the Link Trainer and to perform it well; second, he is sent up in an airplane to do the same thing in actual flight. In this way he has a better grasp of what is expected of him, a better understanding of how to do it and much more efficient training than the student in the BT-2.

From beam work the student advances to a practical application of this aid to air navigation, that is, instrument cross-country flying. This particular phase of Link Trainer flying is probably the most interesting part of the course. Suppose our student's assignment is to make an instrument flight to Pittsburgh. Armed with a map of the United States upon which are printed most of the important radio range beacons and their respective headings, he climbs into the cockpit. He takes off, climbs to the proper altitude and hooks on to the correct leg of the Kelly Field beam that will eventually take him to Pittsburgh. From then on it is his problem to choose the right radio range beacons that will aid him in getting to his destination. After he has flown a specified number of minutes commensurate with the theoretical speed of the trainer and the scale of the map the Kelly Field beam fades out and the student must ask for the new beam. He receives the new beam and continues his course. During his flight he may encounter a cross wind, icing conditions or rough air, or he may even find through the medium of a weather broadcast that Pittsburgh has a ceiling of zero zero. If such be the case, it will be necessary for him to go on to Washington to make his landing. And lest he forget, the recorder is making a permanent record of his flight on the identical type of map that he is using.

If time permits, the student is shown how to make an instrument landing. It is possible to do almost anything in the Link Trainer that one would be able to do in an airplane and do it with one foot on the ground. Although some people may contemptuously refer to it as a toy it has its place in aviation just as surely as the airplane that it represents. Today it is probably one of the most practical methods of teaching. Hundreds of pilots both Army, Navy and civilian can thank the Link Trainer for their certificates as qualified instrument pilots.

Liability Ruling

THE C.A.A. has notified owners of aircraft who lease, rent or lend their planes to other pilots hereafter will be liable to attachment of the planes by the government as security for payment of penalties imposed on the renting flyers for violation of safety regulations. Settlement of a test case in Fort Worth brought the ruling. A U. S. District Court there ruled that the airplane could be sold by the U. S. Marshal to satisfy a $100 fine imposed on an unlicensed pilot who borrowed the plane.

New Transport Engine

THE new Wright G-200 *Cyclone* engine, approved by the C. A. A. with a rating of 1,200 h.p. at 2,500 r.p.m. for take-off, has the same displacement as the engine of 10 years ago, but is lighter in weight per horsepower. Arthur Nutt, Curtiss-Wright vice president for engineering, said that even at 1,200 h.p. the nine-cylinder, single-row radial air-cooled engine "has by no means reached its optimum reliable power output." Ten years ago engineers believed the earlier *Cyclone*, with 575 h.p. for the same 1,820 cubic inch displacement, was within 100 to 150 h.p. of its maximum possible output. Features of the new engine include an all-metal main crankcase and use of a double dynamic damper in the crankshaft. The latter removes undesirable torsional vibration from the operating range of the engine speed and relieves propeller stresses. There is a 24 per cent increase in cooling area.

Ames Is Honored

THE $10,000,000 aeronautical laboratory being built at Moffett Field, Cal., has been named the Ames Aeronautical Laboratory, in honor of Dr. Joseph S. Ames, former chairman of the National Advisory Committee for Aeronautics. Dr. Ames, chairman of the N. A. C. A. for 20 years, retired in October, 1939. The new laboratory will extend the work which has been done at Langley Field, Va.

FLIVVERS

Initial delivery on reported French order for 600, these Stinson "105s" gathered for Halifax flight at Roosevelt Field, N. Y.

For the Allies

by KURT RAND

First U.S. pilots to fly airplanes across border to Canada since war began deliver 33 Stinsons at Halifax for observation use by French army.

WE were the first American pilots to fly planes destined for the Allies to their loading port in Canada. Before we made our trip American pilots had been allowed only to fly the military jobs to the Canadian border. From there the ships were trundled across on their wheels and then Canadian pilots had the job of flying them on to the eastern seaports. But the law was modified in Washington a day or two before we started. We flew them to the border, rolled them across and flew them on to Halifax, Nova Scotia.

They weren't exactly military jobs. In fact they were Stinson "105s." Glorified puddle jumpers. But darned nice little airplanes—really deserving of better fates than the charred and smoking ruins that most of them probably will become in a short time. Because, regardless of what we consider the "105," the French, who were buying them in quantity, intended using them as artillery spotter planes. They were to be in flight at the front. And because they are vulnerable probably to be destroyed with so much other "expendible materiel."

There were 33 of us. Really a few more because some of the boys had passengers. But 33 airplanes all told and 33 pilots. All of us had difficulties. Weather and such. But no one got lost, no one damaged a ship in flying. The only breakage was one wooden propeller. Not bad for 33 ships. We flew on from Roosevelt with the worst of maps. The Stinson people, who apparently organized the flight in about 10 minutes, gave us photostats of Canadian maps beyond Houlton, Maine, and photostats of our own Department of Commerce maps from Roosevelt to Houlton. Did you ever try to read a photostat while flying? It's all one color. The rivers and roads and railroads and power lines all are merely grey lines on a grey background. You have to follow them along to get the cross markings to see just what they are. Sometimes it's impossible to tell roads from streams. Anyway that's what we had.

What did we find when we got to Halifax? Plenty. That dirty little town has had a blood transfusion (literally inasmuch as the war has brought it a new prosperity). The streets are full of uniforms, British and French for the town's full of French sailors from the destroyers, submarines and aircraft carriers that are doing convoy duty from there. The place also is full of Royal Canadian Air Force uniforms. Pilots, mechanics, cadets and what have you.

"There's a war on but nobody's working too hard," was the casual Canadian crack. But actually the Canadians are working as hard as they can in the war. They are straining every muscle to get their pilot training program into action and in fact are taking kids with 100 hours of flying in their logs and trying to make instructors out of them. They're desperate but they are not half as hysterical as a lot of our own people seem to be. They know they've a tough dirty job ahead and are making the best of it.

But back to our flight:

"As far as you know, you are just taking these airplanes on a pleasure cruise. You are not to discuss your trip or your airplanes with anyone. Act dumb or misunderstand or just ignore questions." These were the instructions we got as one at a time we went up to the second floor of the Stinson distributor's hangar on Roosevelt field, got our credit cards for gasoline, $50 for expenses and our roll of lousy photostated maps.

"You fellows had better get out of here as soon as possible," Jim Welch, the Stinson factory representative, counselled us as we came out of the hangar. He pointed to a layer of alto-stratus cloud that most of us had flown over at 5,000 feet an hour earlier. The old pressure. "That stuff's moving in and the field might be closed."

As a matter of fact, Roosevelt had been closed—for two days before that. But there wasn't a chance of it being closed that afternoon. Just the old business to get us on our way. We knew what was happening. But we got out headed for Hartford, Conn., because Boston was reporting 300 feet and half a mile and the field was closed even to airliners.

About 50 minutes later—we arrived in Hartford. There we found another 20 ships ahead of us and a fellow named Klenke who was Stinson's export representative in charge of them. Klenke, a breathless sort of gent who just exuded speed and efficiency, came dashing out to tell us when we arrived:

"Can't wait for you to get refueled. We're pushing on immediately. Try to get as close to Boston as possible. We'll head for Grafton, Mass., and maybe work in from there." With that he and his followers were off. The four of us followed a little later and laid our own course for Grafton inasmuch as none of the earlier ships were in sight. In spite of the lousy report from Boston we found the weather perfect and just kept going. We approached Grafton but instead of landing we kept right on edging in toward Boston. Finally the four

Cross country flying with one man doing all navigation for group of 20 lightplanes may not work out. These pilots were among those who got lost, sat down in Providence.

of us landed at Dennison airport on the west side of the harbor, where ceiling was unlimited and visibility 25 miles. But we could see that the southwest wind had piled up smoke and scud on the East Boston airport less than a mile away. Spires of churches and the tops of gas tanks were sticking up through it. It looked as thick as icing on a cake.

The lot that started out ahead of us, we then found, had wound up at Providence, R. I., for the night. Klenke and company had gotten lost on the way to Grafton and actually had stopped at a point about as far away from Boston as Hartford. Such is cross country when one man does all the navigation.

Next day we went on to Houlton. No trouble except that the country from Bangor to Houlton was the worst of the trip. All of us, it developed in conversation later, sat there thinking: "If she quits now I'll put it down in that lake." The country was so thickly wooded that literally there was no place to get a ship down safely except in the lakes—and there were plenty of those.

Four of us who stuck together got ahead of the entire field by starting early, refueling at Portland and skipping Bangor as a stop. But we ran into a thunderstorm and, by stopwatch, flew around that one for an hour—it must have been at least 100 miles. Even then we just managed to dodge through a little hole to the northeast between the main storm and a smaller but equally black and rain-drenched cloud. We took a real pelting of huge drops for about three minutes while squeezing through the rain curtain.

By that time we were well out over Canada, out over the New Brunswick border. We turned back, identified the St. Johns river, flew right over a big encampment of Canadian troops on an island at Woodstock, Canada, and finally tracked down Houlton on a single-track rail line. The storm had just passed the field (we'd all been afraid that we'd find it still over the field) and the two runways were drenched and running with water.

While we circled deciding just how to get in, a group of eight other planes that we had seen on the ground at Bangor as we went over, popped out of the main storm cloud. We all landed there in the space of about three minutes. The natives were out in force—big-eyed because, they told us, they'd never seen more than three airplanes on their field at any one time before.

It took 36 hours to get the export papers straightened out at Houlton. Not because the U. S. or Canadian customs officials were slow. They were right on the job. They were ready, they said, to have us go right on that afternoon. Some of the boys wanted to leave their airworthiness certificates from the planes with the customs folk and push on to Halifax. But cooler decisions were final. We stayed.

We ran into a lot of Canadian Tommies on a visit to nearby Woodstock, Canada who soon found out we were flying the little observation planes. They said they'd seen us over their camp and had come close to firing a salvo in our direction. The camp has a dozen or more heavy machine guns and light cannon mounted for anti-aircraft defense and the boys who stood guard duty on these guns were just aching to take a crack at us, they said. Seemed to think it would have been sporting to see if they could knock us down. We began to get the idea Canada was at war.

Next day we stalled. Waiting for Klenke and the papers that would let us through. Toward afternoon the rest of the airplanes began coming in. In groups of three to a dozen they came round and settled in—every landing perfect. We staked down, put on fittings for radio antennas and painted out the "NC" license marks on the airplanes but left the serial numbers. And we turned over the airworthiness certificates to the Stinson man who was coordinating the deal for the French.

While we were relaxing word arrived that we would roll the ships two miles down a road from the Houlton field next morning and out to a farmer's field on the Canadian side of the line. That field would be the take-off point. We went up and looked the field over to find it guarded by a detail of 25 Tommies who wore full marching equipment, packs and rifles with fixed bayonets. They said they were there to prevent sabotage. More signs of the war.

That night at the hotel we had a powwow with two Canadian Civil Aviation inspectors. They told us that we would be expected to hold formations, to land at Moncton and finally to follow a narrow "corridor" down between prohibited zones on the last five miles into Halifax. Both men stayed up late that night to draw individual maps for all the pilots showing the corridor, the lakes beside it and the location of the Halifax Aero Club's field at the southwestern edge of the city. More war.

There were five trucks at the airport next morning. The system was to wheel out your airplane, lash the tail wheel to the truck and start down the road. The truck drivers got every ship across without a scratch despite the fact that the clearance between the double line of telegraph poles and the wing tips was less than three feet. Neat work. A round trip for a truck took about 40 minutes. But the entire job was finished in less than six hours.

Everyone got off the field okay and in to Moncton airport. The day was clear and we could see the town of Moncton and the field about 20 miles away. They were burning brush on one edge of the airport and a tall plume of smoke identified the place when we were still 15 miles away. The wind was high there when the first group of eight ships arrived but died down later. The first group was held there for about an hour while the R.C.A.F. mechanics gassed the ships. Then we were off for the last leg.

Homer Stockert of South Bend, Ind., was leading the first eight planes. We closed up on him and flew a pretty fair formation. It was a nice sight from one of the rear wing positions. All the little ships dancing up and down on the thermal currents. Most of us sat there thinking that this was the sort of sight so many British, French and German boys were seeing that same morning—some in fighters and some in bombing planes. And a lot of us were wondering if we would ever see this sort of sight from other planes with more military armament.

Homer took us exactly over our checkpoints. Right up to the middle of the lake where the final turn toward the "corridor" was made. Then he reached the corridor and shook his wings for us to break up and begin the flight down the open zone one at a time. Don't quite know how it happened we got in according to the proper order but we did. At lot of Canadian mechanics in training at the field ran out to help us taxi in. The trip was over as we cut our switches.

The fun was only beginning, however. We got some Canadian ale and a lot of information. The French were expecting our ships and had one of their small aircraft carriers in the harbor to take them abroad. Some of us tried to persuade the commander to let us fly the "105s" aboard but no go. We tried to get aboard but the commandant smiled wisely and shook his head. No go. Wartime and we were neutral aliens. Not a chance.

Halifax, it seems, is the main base whence convoys of from 60 to 100 vessels carrying supplies, munitions and troops, set

(*Continued on page* 85)

Douglas Shearer mounted sample airfoil sections atop his auto to test air pressures exerted on various portions of the new wing.

In 1929 Shearer, Metro-Goldwyn-Mayer recording director (right rear), and studio friends learned to fly. He commutes by airplane.

HE PREFERS SLOTS

by HILL EDWARDS

Influenza and the 1918 Armistice delayed a sound engineer's plans to fly for 11 years, but today aviation is more than his hobby.

ELEVEN years ago Douglas Shearer, head of the sound department at Metro-Goldwyn-Mayer Studios, learned to fly. Ten years ago he bought an airplane. Today he flies the same ship, on which he has installed a few improvements of his own design. He believes that he will have the same plane for several years to come.

It's an Avro *Avian*, now powered with a 90 h.p. Menasco C-4. He installed the engine in 1931 to replace the *Cirrus* with which it was equipped when he bought it. The late Lady Mary Heath flew it from New York to California and left it here with a broker to have it sold.

Shearer (Norma, the movie star, is his sister) uses the plane mainly for a purpose about which every plane owner dreams. He flies from Clover Field, near his studio, to his 550 rolling acres 96 miles by air and 115 miles by road to the southeast. He has two landing fields, one 550 feet long and the other 450 feet and he usually uses the latter because the longer one is boxed on three sides by hills.

He and the Avro have had about 1,000 hours together. They have flown to New York City, to Wyoming, to New Mexico and up and down the Pacific Coast. He has had about 10 forced landings which haven't damaged the ship—and two bad landings which have.

The story of Shearer is the story of every young man who, handicapped by limited income, longs to fly. It is also the story of a man with an inquiring mind who, if he'd been able to get into aviation instead of sound, probably would be a successful aeronautical engineer.

He was born in Montreal. When 15 he qualified as a civilian or cadet instructor in the Canadian Signal Corps. He and a cousin, Maurice Peiler, trained 100 picked men from each war-bound regiment in signaling. Peiler was 17.

"Peiler joined the Royal Air Force in 1917," Shearer relates. "I was glad for his sake, but we'd seen a lot of flying around Montreal and I wanted to be a pilot, too. But I stayed on the ground, because of my age, while Peiler was assigned to the 43rd Pursuit Squadron in France. He was shot down and taken prisoner by the Germans, after being credited with seven victories of his own."

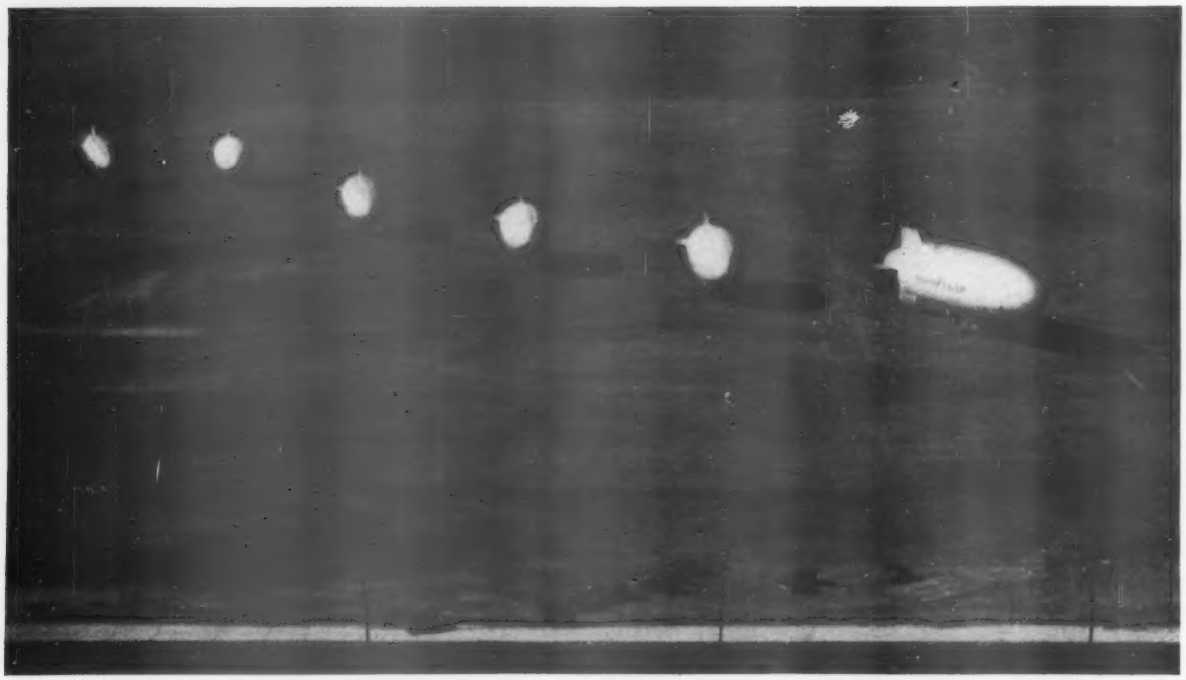
"I was 18 in 1918, made application to the R. A. F. and, while waiting to be called to camp, had a 'flu' attack. Before I recovered, the Armistice was signed. So I never got off the ground."

Thereafter came the long wait. With the war over Shearer, like most young men, was on his uppers. He had quit high school. He didn't have money to attend university, so he looked for a job. He worked in machine shops, learned engineering from a practical standpoint. He spent the next 10 years being "busier than hell" with general engineering and eventually landed in motion pictures—as a sound engineer.

His first chance to learn to fly came in 1929.

"A group at the studio decided to

(*Continued on page* 74)



A fleet of Goodyear blimps prepare to take-off from the Akron, Ohio, airship dock, largest in the world. Goodyear, which built its first airship in 1912, awaits a Congressional appropriation to start work on a new Navy dirigible.

The BLIMP BUSINESS

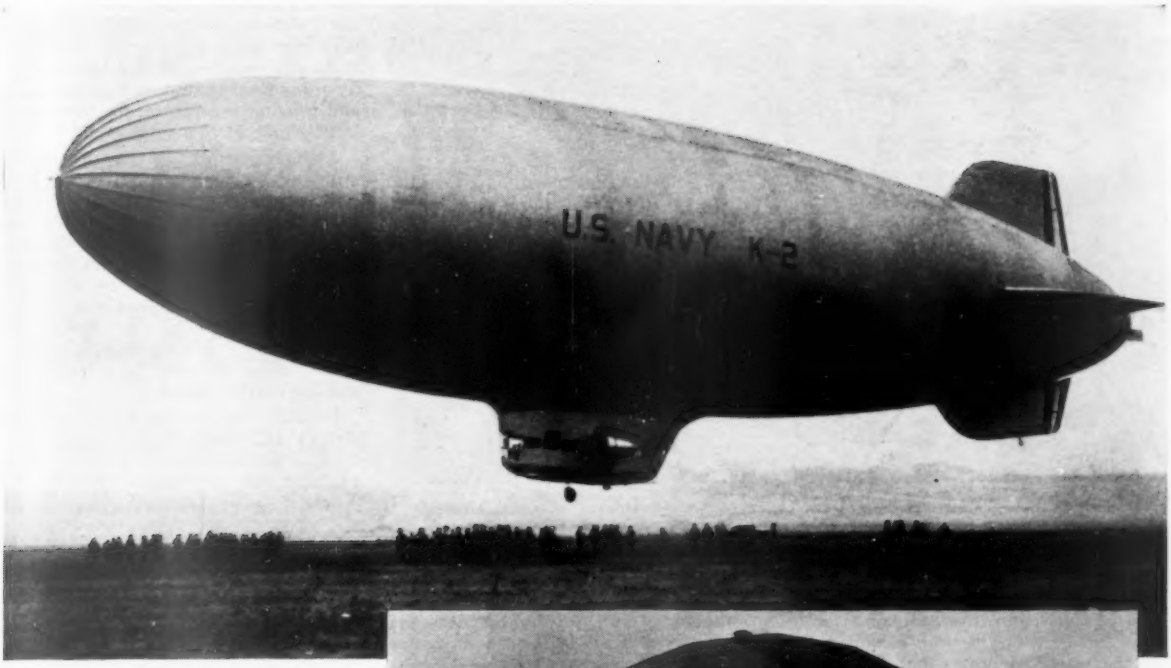
by J. GORDON VAETH

President Roosevelt's request for appropriations to build three dirigibles for the Navy has kindled new interest in airships and their construction.

AFTER an interim of about five years the United States Navy is about to resume experimentation with rigid airships. Although not much publicity has been given to it, authorization exists for a dirigible with a gas capacity not to exceed 1,000,000 cubic feet and length not more than 325 feet. Construction will begin as soon as funds are provided by Congress.

Re-awakened interest in airships can be observed everywhere and the optimism of airship men is not without foundation. Recent developments definitely point to a new era of lighter-than-air craft progress. In addition to the fact that, at this writing, there are pending before Congress two bills providing for vigorous airship construction, the veteran dirigible *Los Angeles* has been completely dismantled. The ship was destroyed, not because the Navy has lost all interest in airships, but (on the contrary) because the Navy wanted to obtain certain information by testing the strength of the structure so that it can incorporate this information into the design and construction of future airships. Therefore it is only a matter of time until the small dirigible and, probably, several much larger ones are constructed. Inasmuch as such construction seems imminent and since most people are not aware that there is an airship industry in the United States, it is opportune to discuss the companies which are actively interested in building rigid airships. Altogether there are six such concerns; each offers a different design.

Foremost dirigible company in the United States is the Goodyear-Zeppelin Corporation, a subsidiary of the Goodyear Tire and Rubber Company of Akron, Ohio. This concern does not at present have a dirigible under construction, but it does construct numerous non-rigid airships and continues to operate its fleet of small blimps. Much of the story of lighter-than-air craft in this country is synonymous with the history of Goodyear for, as far back as 1912, the company was famous for airship construction. In that year, the *Akron* (not to be confused with the ship that bore the same name 20 years later), 258 feet long, 45 feet in diameter and built to carry Melvin Vanniman and a crew of six to Europe, was constructed by Goodyear in 12 weeks.

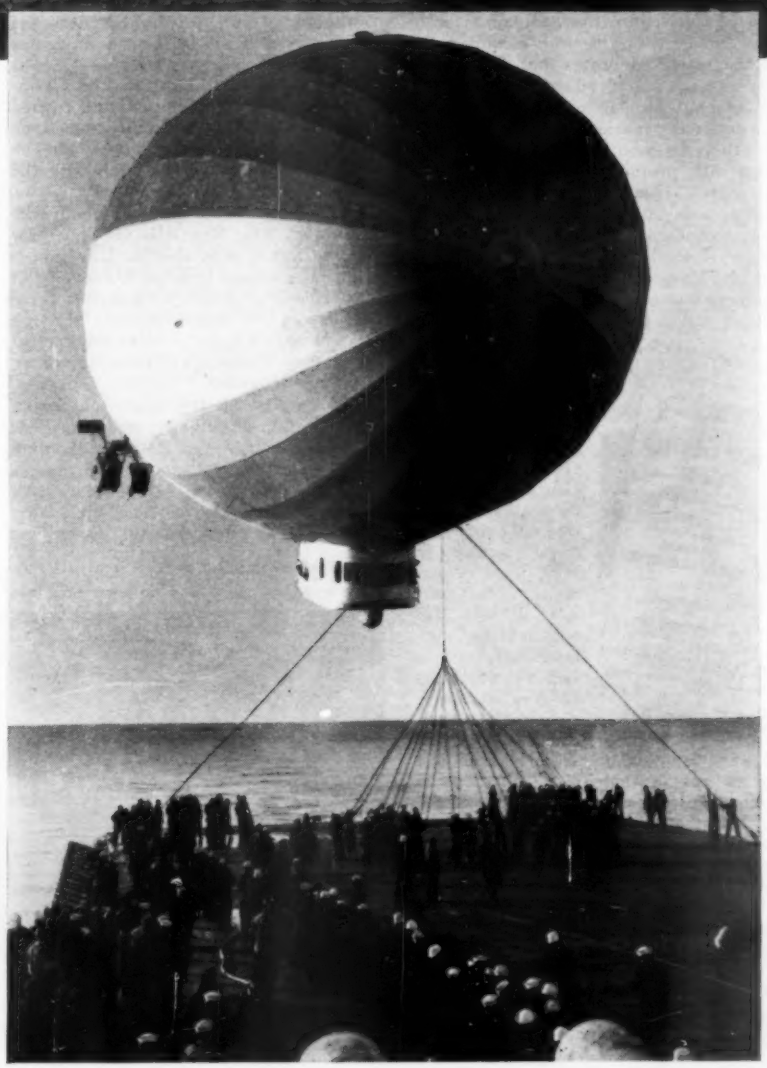


Manned by a crew of seven, the Navy's "K-2" is 246 feet long, carries two 550 h.p. engines.

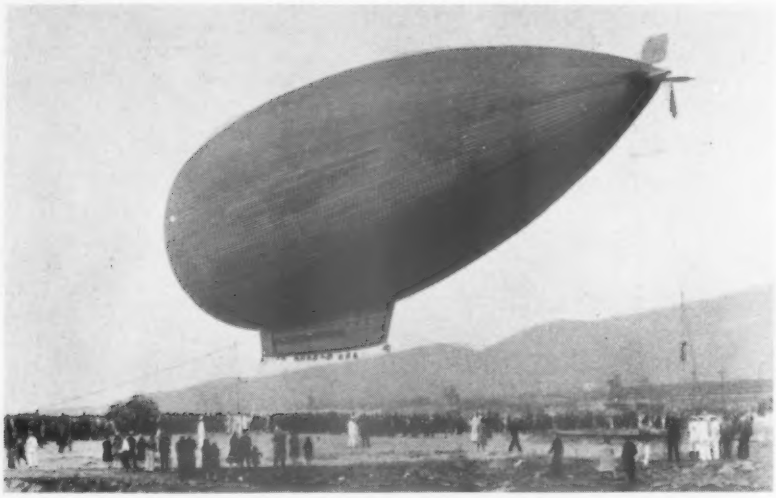
During the World War Akron became the center of lighter-than-air activity; Goodyear, who was joined in the industry for a short time by the B. F. Goodrich Company, turned out airships and balloons as fast as possible. By the end of the war Goodyear had built about 1,000 balloons and approximately 100 non-rigid airships, many of which had been delivered to England and France. The end of the war found the U. S. Army interested in airships and the War Department planning to build a semi-rigid airship. The ship was contracted for with Goodyear who built it in 1924, having just previously manufactured the gas cells for the Navy's rigid, the *Shenandoah*.

The year 1924 was important to Goodyear; in that year the company acquired the Zeppelin patents. Believing that their organization was to be disbanded and their equipment destroyed by the victorious Allies, Luftschiffbau-Zeppelin agreed to transmit their patents and rights to Goodyear who, in turn, formed a subsidiary: Goodyear-Zeppelin. Two years later Congress authorized the construction of two airships of 6,500,000 cubic feet capacity. After two competitions the contract for these ships was awarded in 1928 to Goodyear-Zeppelin. The dirigibles were *U.S.S. Akron* and *U.S.S. Macon* which were completed in 1931 and 1933 respectively.

Such is the story of Goodyear in the airship field. Today the company, with its airship dock (largest in the world) and engineers, is prepared to construct



Now dismantled, the "Los Angeles" was built in Germany in 1923 as a war debt payment.



Short and uneventful was the career of the depression-stricken all-metal airship "City of Glendale." Its covering was constructed of corrugated duralumin sheets.

the Navy's new airship. Goodyear dirigibles are the most familiar fabric-covered Zeppelins; the company is the only one in the American airship field which uses or advocates that type.

When the word "dirigible" is mentioned one immediately thinks of the conventional fabric-covered Zeppelin. But there is another type which has come into prominence and has many prospects. This is the metal-covered airship, a design which is advocated by several concerns. Chief sponsor of this design is Carl B. Fritsche's Metalclad Airship Corporation of Detroit. This company was organized in 1921 to study the possibilities of an all-metal airship. The organization first took the name of the Aircraft Development Corporation and, after securing a Congressional authorization, constructed a small all-metal airship in 1929. This revolutionary craft, the ZMC-2, was 127 pounds *under* contract weights — a fact of which its builders have every right to be proud. The ZMC-2 has proved to be quite successful. It is 149 feet long and contains but 202,000 cubic feet of helium, but it is an exact miniature of the larger ships which its builders plan to construct. One can therefore get a conception of the construction of a large metalclad. The envelope, because it consists of thin metal Alclad plates, would be a rigid body. It would be supported by aluminum and steel alloy transverse frames or rings of triangular section. All weights of the craft, such as the control cabin and the power plants, would be supported by these big frames—which, incidentally have no radial wiring. Running longitudinally and connecting the frames would be small, light girders, the length of which will be broken at regular intervals by small unwired rings. Shear or gas pressure wiring is omitted. After the hull plating had been cut and riveted together, the inside structure would be riveted to it. The sections would be erected vertically as was done with the ZMC-2, then joined horizontally.

Rose's prospectus.

Something should be said about the riveting machine especially developed for building this type of airship. It is almost a sewing machine and has a capacity of 5,000 rivets an hour. It punches three strands of wire simultaneously through the plating, cuts the wire at the correct length then, by means of revolving cams, heads up the rivets.

The merits of the all-metal design have been attested by the excellent performance of the ZMC-2. Helium diffusion is low and, most important of all, surface corrosion of the plating of the metal envelope has been amazingly low. Another advantage of this craft is the fact that the metal covering—Alclad, not duralumin—supports a good part of the direct stresses. Although the ZMC-2 is smaller than many blimps, it is in reality a tiny rigid airship embodying, testing and proving every principle upon which large rigids of this type would be built.

Another concern interested in constructing a metal-covered airship is the American Mechanical Engineering Company. This concern, headed by Thomas B. Slate, is an outgrowth of the Slate Aircraft Corporation, builders of an all-metal airship in 1928. That ship, built in California, was named the *City of Glendale* in honor of the city in which it was built. Unfortunately, little is known about the craft for it had a short and uneventful career.

In 1928, after leasing part of Glendale airport and building a special airship dock, Slate started construction of his experimental corrugated dural-covered dirigible. The *City of Glendale* was almost completed when the depression struck and the company, seeing no reason to rush construction, decided to wait for better financial conditions. During that period the craft often was taken out and tested as a captive balloon. The picture accompanying this article shows the ship during one of these tests. However, the airport changed hands and, since the airship dock was considered a menace to heavier-than-air traffic, the lease was suspended and the company ordered to leave. Since the airship had not been completed it could not be flown away and consequently had to be destroyed in 1931.

The *City of Glendale* was 212 feet long, 58 feet in diameter and had a gas capacity of 300,000 cubic feet. It had a gross lift of 10½ tons, a payload of 2½ tons, a passenger capacity of 40 and an estimated speed of 80-100 m.p.h.

The design of the airship now sponsored by this company is simplicity itself. It is based upon the principle upon which a barrel is built. The construction consists merely of welding strips of corrugated duralumin or Alclad

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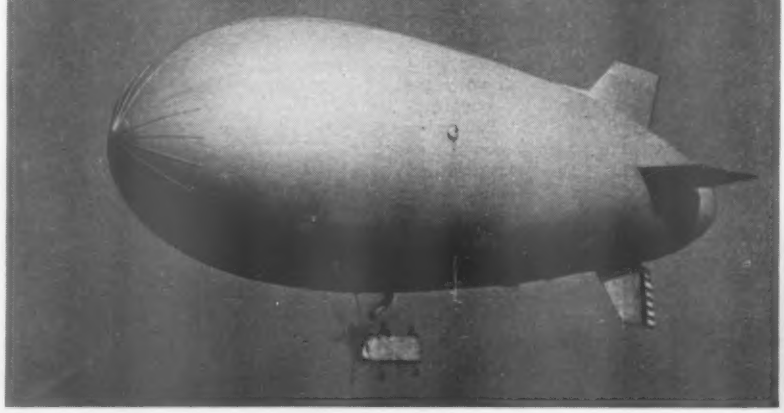
The motorized C-6 balloon is used by the Army Air Corps for observing artillery fire and ranges. Pilot and observer ride in a detachable car under the helium-filled bag.



I Learned About Flying From That! No. 16

by Cloyd Clevenger

A whip-stall landing was fun and gave the crowds a thrill, but one too many spelled a crash which taught this barnstormer a lesson.

Cloyd Clevenger, former flying circus aerobat, as he is today.

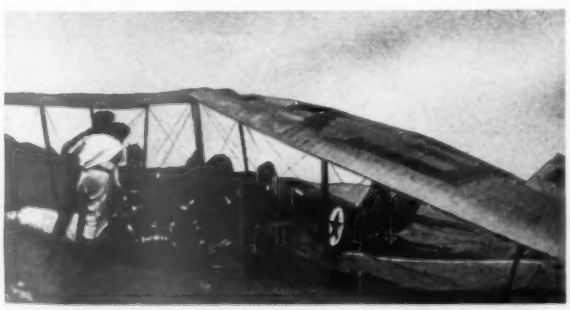
IN the years immediately following the World War we ex-military pilots were a wee bit inclined towards wild aerobatic flying. The public at the fairs and exhibitions used to demand it and anyway we all enjoyed being "hot". A very few of the pilots, mostly Frank Clarke and myself, consistently did whip stall landings in our barnstorming exhibitions. I remember that we were accused many times of causing younger pilots to crack-up because they would go out and imitate us.

To do the stunt we would come tearing in wide open toward the airport. Then we would touch the wheels or just miss the ground at the edge of the field and throttle the motor simultaneously pulling the ship straight up into a dead pan stall 150 to 200 feet off the ground. Now came the breathtaking moment—with all flying sounds gone and the motor just barely ticking over. Next the nose would drop straight down and we would gain flying speed *just* in time to level out and land.

Aviation people really got a bigger kick out of the stunt than did the general public because they realized that if you didn't zoom high enough in the stall you were just out of luck and could not regain flying speed to level out and land. It was quite a sight to see a ship completely stalled and out of control at 200 feet altitude.

During the six years following the war I flew in different flying circuses covering most of the states west of the Mississippi. Passenger hops, fair dates, aerobatics of all kinds, plane changes, wing walking, night exhibitions, etc., and now and then a whip stall landing.

In 1924 I was with the Gates Flying Circus and we were putting on an extra complete show over St. Louis. We had a Texaco sign under the wings of all the Gates ships for which we were given free gas and oil. As we were going into a new district handled by the St. Louis office of the gasoline company it was important to put on a good show.



Ill with an intestinal infection, Clevenger stunted at St. Louis and two whip stalls before landing had this effect on his plane.

Three pilots took off from Lambert Field each carrying a wing walker. The show lasted about an hour with wing-walking, plane changing, and aerobatics all over and in downtown St. Louis. I say "in" because most of the aerobatics were finished down in between the high buildings and the wing-walkers could almost reach the handkerchiefs that the girls were waving from all the office windows. We really stopped traffic that day in downtown St. Louis. Of course, there was no Civil Aeronautics Authority then and the days of the true old flying circus now are gone forever. The Lockear Circus used to do the same sort of flying but you would be shot at sunrise if you tried it today.

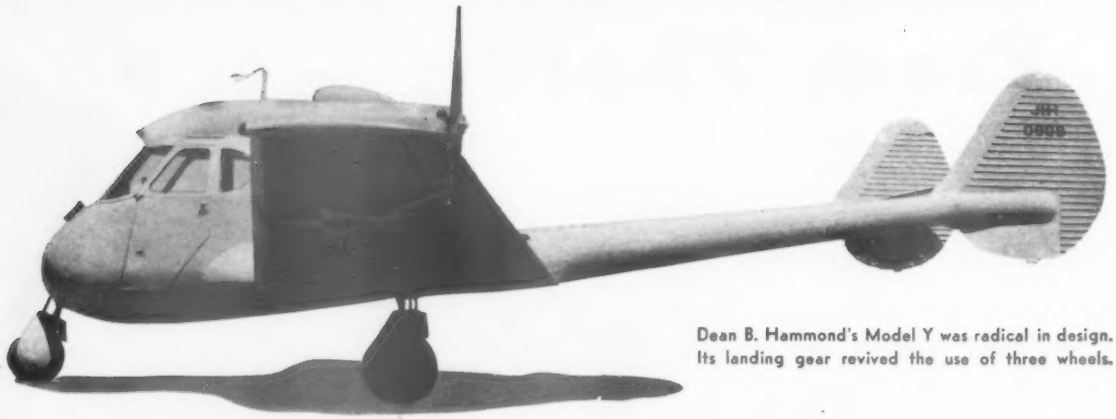
I had been ill with an intestinal infection and was getting steadily worse day by day. Before the flight I was "dog tired" and felt so bad I would rather have gone over to a shade tree and flopped down. However the show must go on—so I flew.

Each minute of the hour of circus flying was like an age. The precision aerobatics between the buildings and the extra heavy work and pressures on the controls to balance the ship with the wing-walker hanging from all extremities of the wings and tail was always hard work physically. Now I was ill to such an extent that I should have been in a hospital instead of in an airplane. I was more than thankful when the show work was over and we could head back to Lambert Field, a distance of 20 or 25 miles.

It was a comfort to take on some altitude where I could cool off and relax. I just kept thinking all the way back that I would fly straight into the airport without even turning, land, get out of the ship and stretch out on the ground, but such was not to be the case. As we approached the airport with plenty of altitude to lose, the wing-walker

(*Continued on page* 88)

THREE-WHEELED



Dean B. Hammond's Model Y was radical in design. Its landing gear revived the use of three wheels.

Waco's Model N (above) applies the tricycle gear to the conventional cabin plane.

GLENN CURTISS started it.

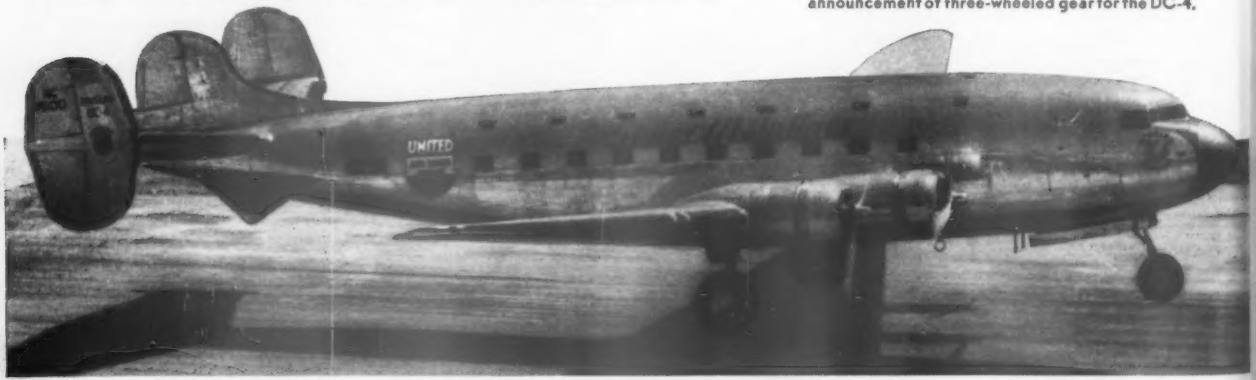
While Wilbur and Orville Wright were landing their first fragile biplanes on skids, the veteran manufacturer decided on a tricycle landing gear. He put one wheel out in front, pushed the center of gravity ahead of the two rear wheels and thus paved the way for an argument which is still going on. Curtiss not only had adherents but imitators. The tricycle landing gear might have stayed if it hadn't been for a single event.

On July 25, 1909, Louis Bleriot, flying a monoplane with two wheels in front and a tail wheel, spanned the English Channel. Bleriot was the Lindbergh of his era. He, too, had adherents and imitators. Right after that, the old timers will tell you, the feud got under way.

Looking at it aerodynamically, the early Wright jobs with wheels and skids were all right—but the skids dragged. Curtiss' idea was fine, except that every now and then somebody would land with the stick too far back and tail surfaces would be smashed. Furthermore, planes were getting faster and both the Curtiss and Wright jobs were scooting across fields farther and farther on landing runs.

Bleriot, when he put his tail down, used the increased angle of incidence of his wings for a brake Bleriot won and

Donald Douglas set the industry agog with his announcement of three-wheeled gear for the DC-4.



DILEMMA by EDWARD CHURCHILL

Glenn Curtiss first used a three-wheel landing gear but Bleriot's tailskid captured designers until Dean Hammond's airplane touched off a tricycle revival.

many pre-war ships adapted the "standard" undercarriage. The tricycle idea had a short vogue at the beginning of the World War when students continually nosed their ships over. Both skids and nose wheels were tried, but the center of gravity was shifted even farther back and both were finally abandoned.

Until five years ago, when Dean B. Hammond popped into the picture with the famous Hammond "Model Y"—later the Stearman-Hammond—the two-wheelers rode nose high, wide and handsome. But Hammond changed the picture.

Today metal-clad "Model Y" is famous, although temporarily out of production. The DC-4 prototype built by Douglas has paved the way for airliners of great size to be equipped with a nose wheel with the smaller DC-5 right on its heels. Vega Airplane Company's new *Starliner*, the unit-twin job, has it. Lockheed Aircraft is tricycling the *Excalibur* and plans the same treatment for all models to come. Waco has hung up a safety record with its "Model N" in the field of private flying. Clarence Chamberlin, famous pilot now manufacturing, has announced a lightplane with a nose wheel. Other experiments are being made by the commercial manufacturers.

Military? Lockheed's twin-motored interceptor pursuit carries it. North American's attack bomber is a tricycle. It is being installed on all Douglases of the attack bomber series. And Bell Aircraft's famous Bell *Airacobra*, called the world's fastest pursuit ship, boasts of a retractable installation which is devoid of "shimmy" after many experiments.

The nose wheel, practically dormant since 1910—a few were used, as well as skids to prevent nosing over during the World War—is back with a vengeance.

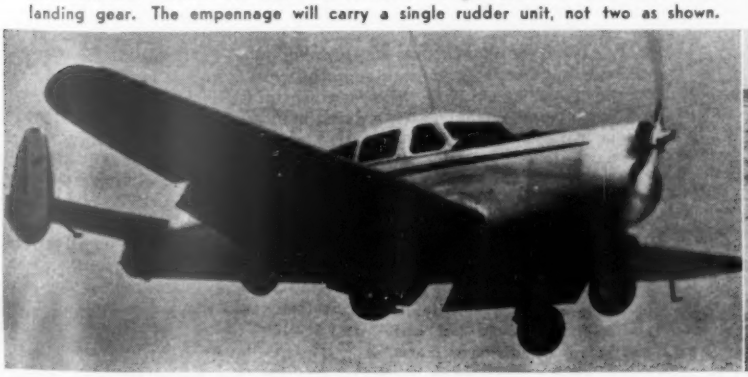
What do the "pros" say? Douglas engineers report:

"The best known advantage of the tricycle gear is the directional ground stability. This is particularly important for blind landing work where landings are made along a given line regardless of

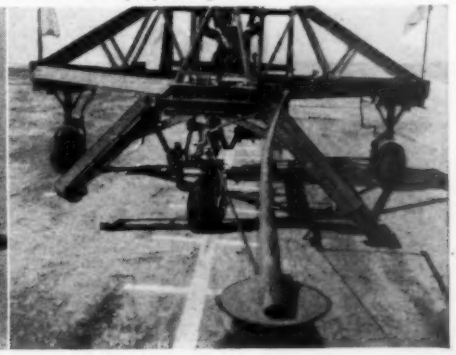
The two-place Ercoupe, powered with a 65 h.p. Continental engine, uses the tricycle landing gear. Stall-proof and spin-proof, it cruises at 106 m.p.h. and costs $2,640.

The Douglas DC-5, recently delivered to KLM, Dutch airline operating in Netherlands West Indies, attains additional, much quicker braking effort with its new type gear.

Mid-Continent Airlines will soon receive its first Vega "Starliner" with three-wheel landing gear. The empennage will carry a single rudder unit, not two as shown.



Vega built this test cart to search out possible faults in the proposed gear for the new "Starliner".



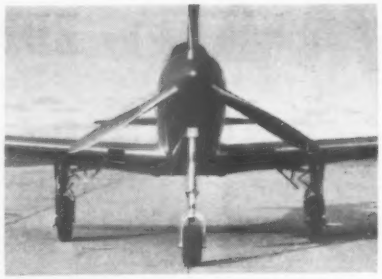
cross winds. It is also an advantage for takeoffs under bad cross wind conditions. It has a distinct safety feature in preventing ground looping under such emergency conditions as uneven braking, side gusts, flat tires and so forth. Because of the directional stability of this gear it is of particular advantage for special types of airplanes which may require long takeoff runs. It is eminently suited to blind landing technique not only because of the directional stability but also because in blind landing it is very often necessary to land with a high rate of descent, sometimes even with the nose down, with relatively high forward speed. Under such conditions the conventional gear will almost always result in a bounce landing because the action of the impact of the wheels to the ground is to increase the angle of attack and create more lift, whereas in the tricycle installation the opposite is true. The high forward speed which often occurs in a blind landing makes necessary as rapid as possible ground braking. It is obvious that more braking effort can be expended when the tricycle gear is used because the nose wheel prevents overturning.

"There are other advantages of the tricycle gear which are peculiar to the type of airplane to which it is adapted. We are not free to discuss the advantages for military airplanes. For commercial transports, however, the fact that the passenger cabin lands and remains on an even keel while on the ground is important, particularly for sleeper planes. In addition, nose-wheeled ships are easier to handle while taxiing and turn in a shorter radius."

Aside from skipping military advantages, Douglas aptly states the case. Fast pursuit jobs equipped with nose wheels obviously can be used to better advantage for blind landings, can be flown into and out of emergency fields better than two-wheeled, tail-heavy jobs by overcoming ground-looping tendencies under cross wind conditions, and can be landed in shorter fields because the brakes may be applied harder.

And the "cons"?

1. Installations are expensive.
2. Unless they are retractable, which means more expense, the result in slowing down cruising speeds—about 20 miles per hour in a ship designed to cruise around 135 miles per hour.
3. They "shimmy."
4. The wings of the two-wheeled plane, with trailing edges lowered due to the drop of the tail, use the wind for a natural brake while the absence of this drag causes wear and tear on the brakes of the three-wheeler.



Bell eliminated front wheel shimmy with its tricycle applied to the Army's YP-39.

What of Hammond, the man responsible for the re-birth of the old idea? Hammond is the true later-day pioneer for he started his experiments in 1932.

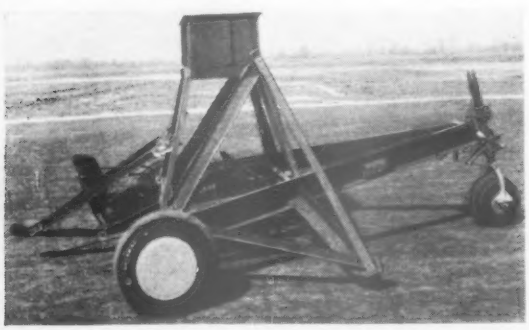
"After making a few conventional three-place biplanes in that year," he says, "I became convinced that before private airplane manufacturers could hold their heads up they must present a product with greater utility value. I felt that basically two essentials were necessary to attain this end. First, airplanes should be about 20 per cent as difficult to fly. Second, they should be cheaper to buy, operate and maintain."

In 1933 a mock-up of Model Y came into being. Hammond used the tricycle for safety and an automobile motor for economy. Next came the famous Bureau of Air Commerce "$700 plane competition," which resulted in Hammond yielding to demands for an all-metal job and more horsepower. The first "Model Y" flew in 1935 and was delivered to the Bureau of Air Commerce in 1936.

"Oddly enough," Hammond says today, "the cooling system gave us far more trouble than the landing gear and consumed most of the experimental time."

Stearman-Hammond Aircraft Corporation came into being in the summer of 1936. Production actually started, with the ship costing $6,500 and with a backlog of orders, in 1937. Then came the second "recession" and orders were cancelled. It was not the innovation of the tricycle gear which caused the "Model Y" to fail on a mass production basis. That lived on. It was the "recession" plus the high cost of the all-metal ship with an aircraft motor.

"We built and sold 19 'Ys'," Hammond says. "The drawings, jigs, parts in process and so on were sold to a group in the Northwest and a resumption of manufacture is planned. While I am not manufacturing at present, I am still 'sold' on the tricycle as is everyone who has flown it. I live for the day I can start construction of that airplane with high utility value which includes ease of handling, safey, low original and upkeep costs. I have the plans developed."



"Airacobra" landing gear underwent roughest treatment on ground test cart before installation on plane.

The report on the test work for heavy ships shows what a trend Hammond started and the problems he introduced. Douglas' two-fold experimentation was necessary before the design was applied to the DC-4. First, a test card, which simulated the chassis of an airplane, was built and equipped with the gear. This cart was towed around Clover Field at Santa Monica and various adjustments were made to determine the optimum configuration for the various components of the tricycle landing gear. The cart was designed by V. Pavlecka, Douglas engineer, and tests were run by another engineer, J. R. Goldstein. The second phase was the installation of a tricycle landing gear on a Douglas *Dolphin*. This particular type was used because its hull structure by its nature was sufficiently strong to carry the loads imposed by a nose wheel with a minimum of additional bracing. These tests were engineered by C. G. Brown. Tests on the *Dolphin* proved the complete practicability of the gear for the DC-4.

Douglas produces an explanation for the dormant period from 1910 or thereabouts to 1935 when Hammond first proved its present value.

"The tricycle landing gear idea was dormant from the time of Curtiss until rather recently because the need for it has been relatively recent," Douglas engineers said. "The really light planes were fitted with neither brakes nor tail wheels. Since no brakes were used the center of gravity was very slightly aft of the centerline of the main wheels and the only braking was that obtained by the high angle of attack of the wings of the plane in landing position plus the friction of the tail skid.

"The relatively far forward center of gravity of these early light airplanes with respect to the wheels resulted in ground looping tendency so slight as to be of minor consequence. However, the application of brakes made necessary considerable rearward movement of the center of gravity which increased the ground looping tendency to a point where tricycle gear became advantageous. It was not adopted as soon as the brakes were installed simply because of economic and weight considerations.

"For large airplanes the adoption of a tricycle landing gear represented something of a major change in design which had to be very carefuly studied before anyone would be willing to risk an investment of $1,000,000 or more on a large experimental airplane."

Douglas' tests were equalled if not bettered by Vega. Out at Metropolitan Airport, Van Nuys, where movie stunt men dive planes and race cars and private fliers skittle in and out, Vega produced an automobile and three-wheel trailer, the latter being the forerunner of the tricycle landing gear now going into both Lockheed and Vega production. The trailer had rear wheels about 20 feet

(*Continued on page* 84)

Hydraulic systems, the most efficient method known to aircraft engineers, operate landing gear, brakes and flaps.

Aircraft Hydraulics

by OWEN T. WYATT

Three hundred years ago the principles which govern our airplane retraction systems were worked out by Pascal, a French mathematician.

VERY little has been written on the subject of hydraulics as employed in the remote control and operation of aircraft devices. The lack of such material is likely to be due to the rapid evolution of use of the fundamentals of hydraulics.

Today, hydraulic systems are unexcelled for actuation, effort transmission and translation. In the retraction and extension of landing and beaching gears, operation of folding wings and landing and diving flaps, remote control and operation of engine cowl flaps and bomb bay doors and landing lights and gun turrets they are preferred. Hydraulic energy also is used to provide the power for operation of primary controls and brakes on large airplanes.

This article is intended to review the fundamental laws and principles of hydraulics and to provide the introduction of the applications as employed in the general systems of remote control and operation. As such, the applications used in the highly successful and reliable control and operation of such devices as the Hamilton-Standard propeller and the Sperry gyro pilot will not be discussed.

The fundamental law of hydraulics first was stated by Blaise Pascal (1623-1662), early French mathematician. Any external force exerted on a unit area of a confined fluid is transmitted undiminished to every unit area of the containing vessel. In this fact lies the secret of effort transmission when force has been translated to pressure. Pascal put it into these words: "If a vessel full of water, closed in all parts, has two openings of which one is 100 times the other, placing in each a piston which fits it, the man pushing the small piston will equal a force of 100 men who push that which is 100 times as large and surpass that of 99. Whatever proportion these openings have and whatever direction the pistons have, if the forces that apply on the pistons are as the openings, they will be in equilibrium."

Diagrams No. 1 and 2 are used to further illustrate the law and principles of hydraulics. In No. 1 we have a vessel with three openings of different size in which any external force applied on the piston in any opening will be transmitted by the liquid content of the vessel, undiminished, to the other openings of the vessel. Diagram No. 2 clearly shows the point of proportion as it will be seen that the pressure on the large piston is one pound to each square inch, just as on the small piston. Then there must be 100 pounds on the large piston to balance the one pound on the small piston. Therefore, their force is directly proportional to their area. The same principle still remains true even if the two vessels of these diagrams were connected with a small line.

Hydraulics has its most outstanding application utilized in the automobile brake field. Equal force applied to four or more points at one time—highly impractical with any form of mechanical motion—is so easily achieved with hydraulics that it is used by every manufacturer of passenger automobiles in America. Other everyday applications are the barber and dentist chair, the

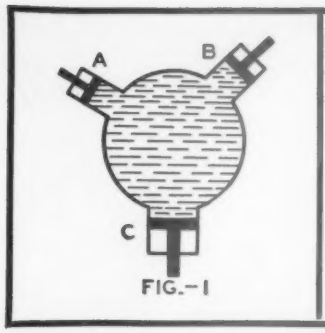


FIG.-1

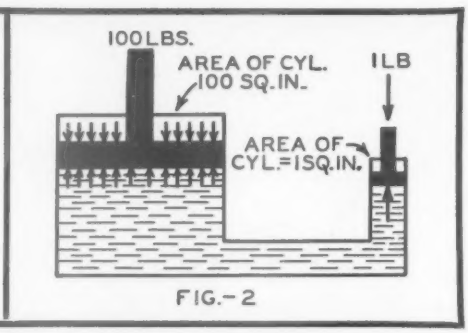


FIG.-2

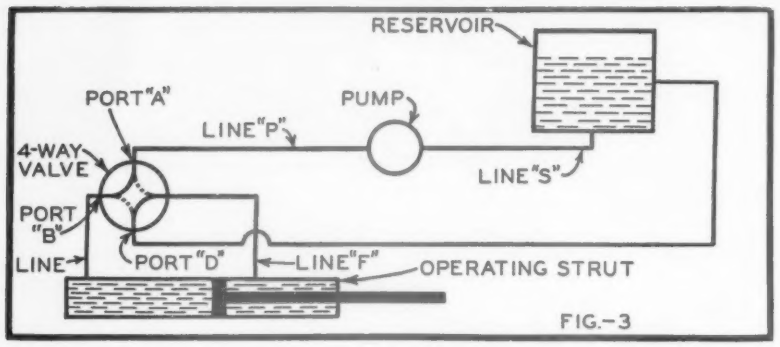


FIG.-3

automobile jack and the dump truck body hoist.

The simplest form of a general hydraulic system for the operation of an airplane device would comprise the following units: A reservoir, hand pump, four-way control valve, operating cylinder and the necessary tubing and lines to connect these units. Such an elementary system is schematically shown in Diagram No. 3.

The reservoir through line S (supply) furnishes fluid to the hand pump. Manual energy or force is translated to pressure on operation of the hand pump. This hydraulic energy of fluid under pressure is transmitted through line P to the four-way control valve where the direction of motion of the operating cylinder is obtained. In the diagram the four-way valve is shown with four ports—A, B, C and D. Two heavy lines dissect the valve and are marked A-B and C-D. The two dotted lines marked X indicate the position of the heavy lines when operation of the operating cylinder in the opposite direction is desired. As shown, ports A and B are connected by line A-B, therefore the pump product is being diverted into line E. As the fluid is directed into the operating cylinder the hydraulic pressure is translated into force. As the force causes the piston of the operating cylinder to extend, the fluid on the opposite side of the piston head is directed to the reservoir through lines F, R and the four-way valve. The evolution is reversed with the rotation of the four-way valve, when the line A-B connects ports B and C and the line C-D connects ports A and D.

To understand the mechanics of the elementary system let us assume that the hand pump of the system has a displacement of one cubic inch with each stroke, a total of two cubic inches per completed cycle—developing a pressure of 1,500 pounds per square inch from a force of 60 pounds exerted on the handle. Now let's assume that the operating cylinder has a bore of 1⅛ inch (area: .9940 square inch) and a total length of 18 inches between the cylinder end and the piston head when

(*Continued on page 72*)

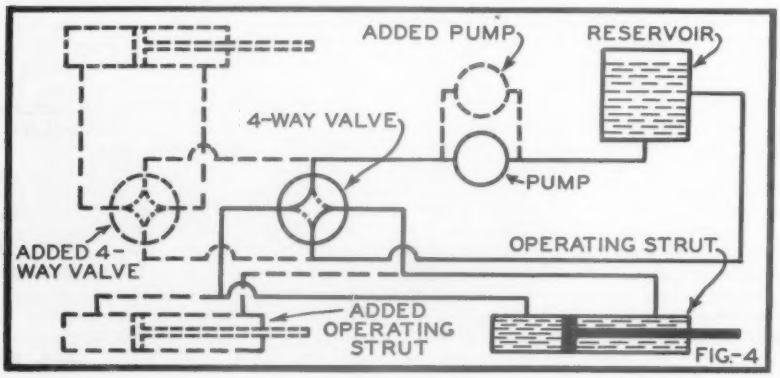


FIG.-4

Mercator Navigation

by P. V. H. Weems

WHEN covering long distances, either at sea or in the air, the approximate great circle track is usually followed because it is shorter than the Rhumb line course.

It is not practicable to steer a great circle course continuously, since to do so it would be necessary to change the compass heading continuously. In practice, chords of the great circle track are followed with little resulting loss of distance.

The essential problem, therefore, is to find the great circle course at points along the great circle track. The great circle course may be computed accurately by any of several standard methods, but the computation is somewhat tedious, and since the great circle course changes as one travels along the track, numerous courses must be computed.

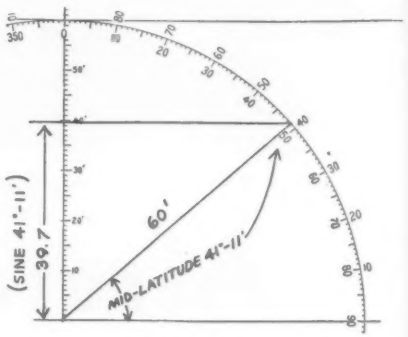


Figure 1

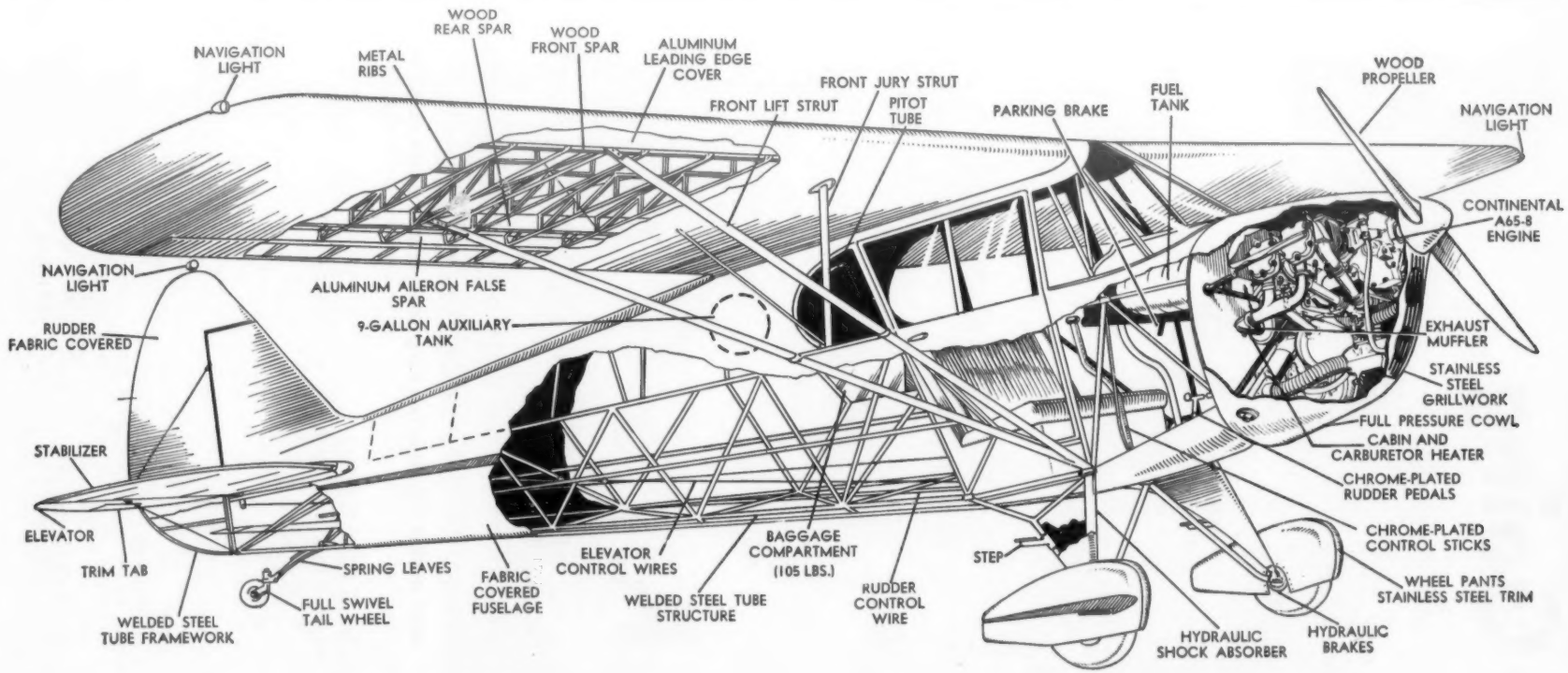
While we have the choice of either computing the great circle course or of converting the Rhumb line course to the great circle course, there are many advantages in making the conversion rather than making the entire computation. This is true in spite of the fact that the computation made independently is more accurate. Great circle courses may be computed to within a minute of arc, which obviously is closer than it is practicable to steer.

On the other hand, Rhumb line courses may be converted rapidly and to within one to two-tenths of a degree by any of several methods. The formula for the conversion of Rhumb line courses to great circle courses is:

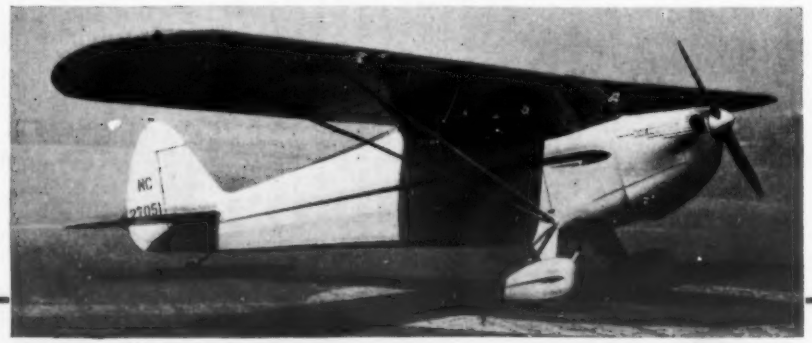
$$\text{Conversion angle} = \frac{DLo}{2} \text{ sine } L_m, \text{ or}$$

Conversion angle equals half difference of longitude multiplied by sine of mid-latitude. The accompanying table gives the conversion angle for converting great circle courses to Rhumb line courses and vice versa for the arguments, difference of longitude and mid-latitude. Definite rules may be given for applying this conversion angle, but common sense provides a better rule when it is firmly fixed in mind that the great circle track lies

(*Continued on page 80*)



THE PIPER CUB COUPE, A CUTAWAY DRAWING



THIS cutaway drawing of the Piper *Cub Coupe* showing construction details is the first of a series on popular private aircraft. Similar drawings of other airplanes will appear in future issues of FLYING-POPULAR AVIATION.

The two-place *Cub Coupe* is powered with either a Continental or Lycoming 65 h.p. engine and has a cruising speed of 97 m.p.h. at 2,150 r.p.m. With 105 pounds of baggage and 25 gallons of gasoline, it weighs 1,301 pounds loaded. The wing span is 36 feet two inches, height six feet 10 inches, length 22 feet six inches. The *Cub Coupe* sells for $1,995. Operating cost is estimated at $1.87 per hour, excluding hangar storage. Performance figures include a cruising range of 300 miles, stalling speed of 41 m.p.h. and service ceiling of 16,000 feet. The propeller is wood with fixed pitch. Features include exhaust muffler, full pressure cowling.

So You're Going For a Flight...

"First-timers" usually are relieved of any fears by calm routine of scheduled airline flights in planes like this Douglas DC-3.

by **E. JAY DOHERTY**

Do not look for any thrills on your initial venture into the air, but be sure to select a reliable pilot and make certain his airplane is in good condition.

THEY tell the story of Charlie Blank who wasn't going to be caught napping on his first flight. He showed up with his pen wrapped in tissue paper, with gum to keep the pressure on his ears equalized and cotton to keep the noise out; with two sweaters, a jacket and woolen muffler. He was well prepared but it seemed there was something he had forgotten, some little item he meant to attend to before making the flight. He couldn't remember it. But after the motor had fallen out of the plane and Charlie was being carted away from the wreckage in an ambulance he recalled what it was he had forgotten and smiled at his oversight. It took a crackup to remind him to find out whether the plane was in good condition.

Many people making their first flights figure there is nothing to do but cross their fingers and hope for the best. But even the most unversed novice can follow a routine before making his first flight that will do him more good than insurance and make him feel more secure on his first and subsequent air trips than the most potent good luck charms.

While it is impossible for you, the layman, to make a check of an airplane's engine and structure before going up you can do the next best thing. Ask questions. Find out from habitués of the field how reliable your pilot is. Ask to see his license. All pilots are required by law to carry their certificates of competence with them. And being a vain group of professionals they are usually only too glad to show their papers.

Airplanes are inspected and certificated at least once a year by the Civil Aeronautics Authority. When you enter a private plane look for the license. It will be posted in full view and it has on it information in which you are vitally interested. How much load can the plane safely carry? The certificate will tell you and you can see for yourself whether it is overloaded or not. The C.A.A. also requires that a plane undergo a line check every seven days or each time it has been flown 20 hours. Fnd out by discreet inquiry whether that regulation has been complied with.

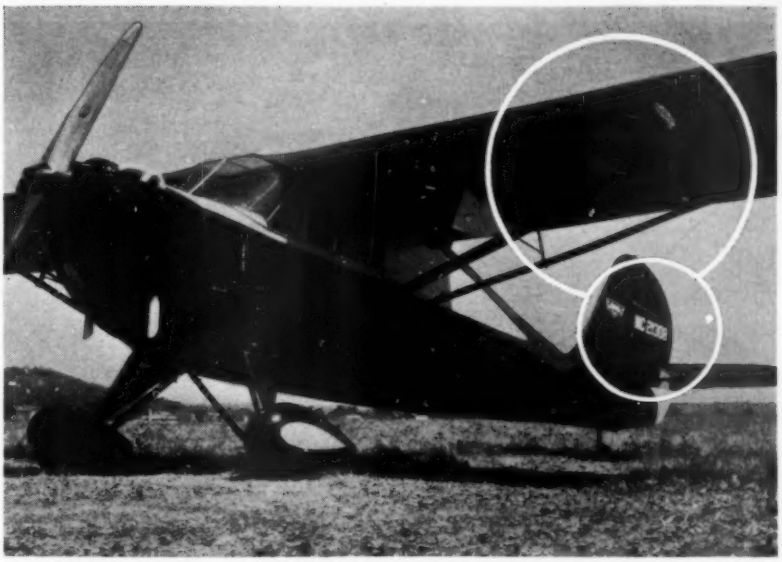
Learn something of the character and personality of the owner. You must know how insistent he is that his plane be in good condition. Is he a happy-go-lucky guy who just doesn't give a hoot? If he is postpone that trip. Be certain that the registration numbers of the airplane in which you fly are prefixed by "NC".

If you look into those things you won't have to cross your fingers before boarding the plane. You can be sure that

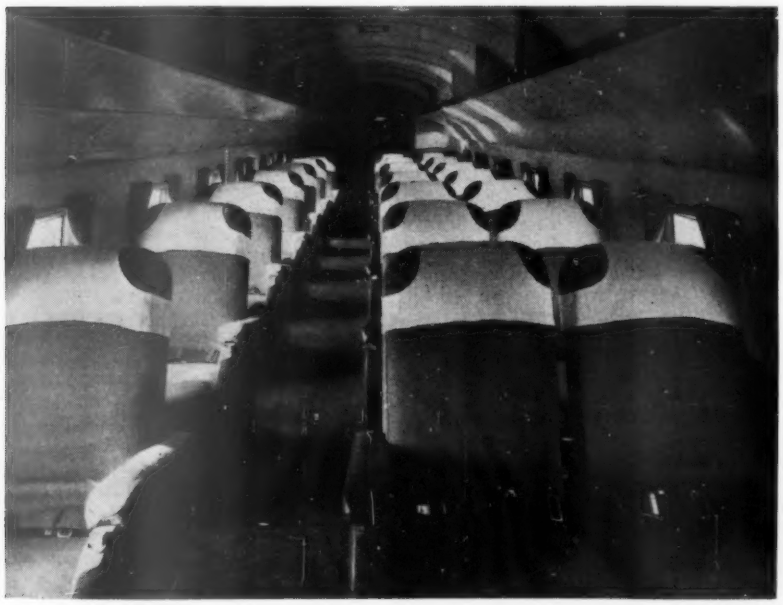
if anything does happen it won't be because the pilot or plane was under par. Safety is the first and most important consideration in making a flight; but if you are out for pleasure it is not by far the only factor you should think about.

E. F. Southee of the private flying development section of the C.A.A. in New York recommends that you make your first flight on a day when the sky is clear and the visibility unlimited. He believes that the only thrill you should look for on a flight is from the earth as it spreads out in a new dimension, startling, vast and beautiful. While an airplane of itself can be thrilling it is usually terrifying to a first flighter if put through its repertoire of tricks. He says the man—or woman—who is apprehensive about flying should initiate himself in the air by a flight on a scheduled airline. The routine of sending up an airline flight in itself is soothing. It is a prosaic matter of selling tickets, loading a plane in much the same manner as a train and dispatching the ship at the scheduled departure time.

This is all done without a flurry of excitement. The passengers are mostly seasoned air travelers who think no more of boarding a plane for a long trip than they do of taking their commuters' train to work in the morning. You are put at ease upon entering the plane by the stewardess or steward. It is necessary to fasten your seat belt only during the take-offs and landings. In flight you are free to unfasten the belt and walk around in the plane, play cards or watch the scenery.



First-flighters should be sure the "C," signifying C.A.A. approval for passenger use, is in the license number. In international code "N" is the United States' designation.



Seat belts in transport liners sometimes disturb the person making his first flight, but they are there only to prevent nasty jolts during turbulent weather, minor hazards.

You—being a first rider—are naturally tense at the start of that trip through the air. You're departing from all that is familiar and you can't be at ease unless you stay up long enough to become enraptured with the freedom of flight and the new vision of the ground below. Your first flight should be a long one. Fifteen minutes in the air isn't enough for you to get over your wonderment at the new machine you're in, Mr. Southee says. It doesn't give you time to settle down and enjoy the scenery and realize there is no fear of falling from a plane at 50 feet or 5,000.

Even so some airline officials believe more new business has been garnered through sightseers' flights between New York and Newark than through any other means in the last six months. That flight is only 15 minutes each way and costs ridiculously little. It is just long enough to dispel any preconceived fallacies people may have about flying.

Make you next trip out of town by air. If the question of safety is holding you back reflect for a minute and you'll realize that the safety record of the airlines for the past year is untouched by any other form of transportation. Flights are cancelled if there is the least question of safety involved in their operations. You'll be surprised to find there is no sensation of speed in an airplane. There is no dirt and very little noise. You'll be able to carry on a conversation in normal voice. Other customary annoyances of traveling will be left on the ground.

Here are a few tips: When the plane banks bank with it and you'll hardly notice the turn. Relax; seats are adjustable. Don't worry about slipping out of place if the plane is ascending or descending; all changes in altitude are made gradually including the take-off and landing. If you want anything ask for it; everything is carried on planes fom aspirin to *Esquire* and the cabin attendant is there to cater to your whims. Keep your baggage weight down to 40 pounds; over that figure it will cost you from two to 75 cents a pound depending on length of trip.

However it is hardly necessary to list all the conveniences of flying. It's a known fact that one has only to take a trip on an airline to be sold forever on flying. Occasionally the companies operate scenic flights to accomplish this purpose. If you're interested telephone your nearest traffic office and tell them you'd like to take a free trip as an experiment. They will list you as a prospect and see that you get up on the next scenic. You don't have to worry about the condition of the plane or ability of the pilots on airline trips. Both the vehicle and the personnel are checked frequently and are made to conform to stringent requirements.

Passengers flying in other than scheduled airline ships should make sure that this license and airworthiness certificate is in the cockpit. If it is not, steer clear!

On the other hand there are so many hundreds of persons who have flown once and have never gone up again that officials of the C.A.A. have come to the conclusion that short sightseeing flights and brief spins with barnstormers who promise a "thrill a minute" have done civil aviation much harm. Don't fly with showoffs. Don't fly with any one who isn't highly recommended by his confreres.

Established sightseeing companies who work from a fixed base and use equipment mechanically above question will do all in their power to make your first flight a pleasant one because they want you to come back for more. Ask questions about their pilots and equipment. Find out where they will take you. Compare their prices with those of the fly-by-night pilots who hop passengers on their Sundays off. And if you find them slightly higher remember that it takes money to employ competent mechanics. The difference in price may be your margin of safety.

If you are invited to accompany a friend on a trip ascertain whether his rating allows him to carry passengers. If it is to be a long flight find out whether he's had cross country and night flying experience and how much of it. See whether or not he checks his weather and make a point of learning whether his plane is equipped for instrument flight. All those questions having been answered satisfactorily don't pack your bag as you would for a Pullman trip. Remember space and weight are at a premium in private planes. Don't—unless he operates an open plane—dress too warmly. Cabin ships are equipped with heaters.

Keep in mind that your first trip probably will not be your last. You can experience all the fun of flying only over a period of time. Your first flight will be remembered chiefly for the new slant it gives you on the territory over which you fly. Don't go up in an open cockpit plane for your first taste of flying. The wind grabs at your hair, wrings tears from your eyes, pulls at your clothes. All you are really conscious of is the rush of the wind. If the day is warm and you're seeking relief from the sultry earth you'll get it just as well in a cabin plane with an open window. In short make your trip as pleasant as you are able. A roller coaster will give you more sheer physical elation than an airplane ride, so if you're seeking thrills go to Coney Island but stay away from the airport.

Widespread notions about "air pockets" and up-drafts and down-drafts persist in frightening prospective first flighters from actually trying their wings. No one will deny that atmospheric conditions sometimes cause unusual air mass activity that jounces airplanes around a bit but such conditions are unusual and frequently can be avoided. Turbulence in the air is not dangerous to the experienced pilot.

Winter flying is another bugaboo that shows all the signs of becoming a forgotten fear. The airlines have piled up statistics in 10 years of operation that prove cold itself is no deterrent to flying. Combined with unfavorable conditions it is but those conditions being known operations are suspended when the safety of passengers or equipment is involved. On the contrary flying is more generally smooth during the cold months than during the summer.

Many first riders are frightened when asked to fasten their seat belts. They scare at the implications they read into that convenient gadget. Actually the safety belt is not intended to save anybody's life in the event of a total crackup. It is there to prevent you from taking nasty jolts during turbulent weather, rough landings and minor hazards such as noseovers and ground loops. Be sure it is fastened around you during all landings and take-offs at least but don't let it hamper you in flight.

You may be surprised to feel your ears clog up after the plane takes off. Give an occasional yawn to get rid of the choked ears or swallow frequently until they feel normal again. It is the same change in air pressure you have experienced in elevators and is not to be taken seriously. Infrequently after quick descent from high altitudes some persons have sharp earaches. This is caused when one fails to equalize the pressure on his ears as fast as it is increased. The best remedy is to take a long drink of water. Airlines supply their passengers with gum to keep a flow of saliva for swallowing. If your first flight will be an extensive one take along a package of gum just in case you need it.

You hear a lot of nonsense about airsickness. Don't even think about it. It is well agreed than when healthy people get airsick it is largely mental. But if you must know—less than one per cent of all airline travelers get sick. If you are worried about it don't eat a big meal before going up; don't wear constricting clothes. If you give yourself up to the enjoyment of your flight sickness will never enter your mind. Babies incidentally are the best travelers in that respect. In years of dealing with air travelers, the airlines yet have hear of a baby who suffered from that case of the jitters known as airsickness.

It shouldn't be necessary to advise prospective first riders not to drink liquor before or during their trip because pilots are liable to lose their right to operate if they carry intoxicated passengers and are usually perspicacious about accepting such persons. But there are pilots who are not careful in this respect so remember a man gets drunk faster and sick more easily at higher altitudes than on the ground.

At the rate the aviation industry is expanding, with more passengers traveling the airlines every day, with more plane manufacturers stepping up their output—and what's more—selling their products, with the public becoming more and more air-conscious, you are bound to be asked by a friend or acquaintance to accompany him on a flight soon. When that time comes, friend, remember to consider first your safety then your comfort. Have a good time, and please, don't step into a moving propeller.

END

Busy BT-9's

RANDOLPH FIELD'S 173 North American BT-9 trainers flew 14,807 hours in January, 1940. Out of that month, only 21 days were flyable, which gives each airplane an average of 4 hours' flying for each flying day. Of the Army training center's four squadrons, the 53rd School Squadron stood out. The 53rd's 42 planes flew 3,838 hours and 50 minutes, an average of more than 91 hours per plane. At the BT-9's cruising speed, the Randolph Field trainers flew 2,072,980 miles in January.

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

IF you are a pilot, we ask that you read the following and help AOPA in a new endeavor which should affect all pilots whether AOPA pilots or non-members.

For many months AOPA has received emergency calls for pilots to come to the aid of sick persons or other urgent calls requiring the use of aircraft and volunteer pilot personnel. Most of these calls have been satisfactorily executed by the AOPA. Our pilots have flown medical aid to rural districts, flown emergency operative cases to city hospitals, flown food to starving ducks, hunted for stolen boats and have answered many other similar calls.

Frequently our country experiences national domestic emergencies such as flood, earthquake, fires, hurricane and so on. AOPA has been called upon to organize a volunteer corps of pilots who may be available for these national disasters and to answer calls for individual emergency cases as mentioned. AOPA has agreed to set up a card index of pilots who may volunteer for this service. One need not be a member of the AOPA to register with this volunteer corps. No obligation is connected with this registration, although we request that *only those who will make themselves reasonably available to emergency call register for this work.* We do not want to have our files cluttered up with dead wood.

This is a serious business. When pilots and ships are needed, they are usually required in a hurry. AOPA must be in a position to locate the pilot or pilots nearest the scene of the catastrophe quickly and dispatch him to the proper authority. There is often a need for small ships as well as larger planes. We do not expect that each and every pilot who registers with us for this work will be available 100 per cent of the time, *but we must insist that those registering do so only if they intend to make themselves available within reason, if an emergency comes near their area.* When such a call comes, it many times involves saving a life. We can have no "good-will gestures," we must have real and sincere cooperation from the pilots who signify their intentions to join those already active in this work. Pilots must own or have ships available to be of any use in this work.

Those pilots wishing to register in the AOPA Emergency Pilot Corps—write your name, *complete address and telephone number,* your license number and grade (with ratings, if any), the airport which you would fly from, and the radius that you would be willing to operate in if called upon; i.e., 50 miles from base, 100 miles, 150, 200, etc. Send this information to AOPA's New York office, 415 Lexington Ave., New York City. This information will be placed on individual cards and filed geographically. After preliminary filing has been accomplished, we shall send out a form which pilots may fill out and return to us for more complete information, such as whether the pilot has night-flying experience or not, etc. Pilots! Because you fly, you have at your command the ability to transport persons or supplies at high speeds. Speed is essential in times of disasters. You may save a life or relieve great suffering if you will vounteer to put your skill and knowledge into this effort of the AOPA. Register *now!*

Practice Drills of Relief Service

In line with the foregoing, the AOPA now is actively putting into action a second step in the direction of utilizing civilian piloting skill in times of disaster or domestic emergency. AOPA has established a system of about 160 units throughout the United States, clusters of AOPA pilots at strategic points. It seems likely that these may serve as the framework for the execution of a series of "practice drills" in civilian relief service.

The first of the practice drills has been set at the time of this writing for July 4th. Other drills will follow shortly in different communities. The rehearsal program for these drills was prepared jointly by J. B. Hartranft, Jr., executive secretary of the AOPA, and Ruth Nichols, AOPA member and executive director of "Relief Wings." AOPA is to provide the pilot and plane personnel and Relief Wings is to organize the ground functions including the co-ordination of Red Cross, Aerial Nurse Corps and other agencies that would normally be required to function at the time of disaster.

Pilots throughout the country will be kept in close touch with the development of air-relief technique and its progress both at home and abroad. These practice drills will give our pilots useful experience to cope with difficult problems of terrain, take-off and landing in remote and undeveloped areas. By such drills, AOPA officers will be able to develop a technique which will function almost instantly whenever the need arises.

First Simulated Flight

The first of these simulated disaster relief problems will be set up on July 4th at Greenport, N. Y. Two years ago this village on the northern tip of Long Island suffered great losses when a hurricane struck suddenly leaving mass wreckage in its wake. The entire flight will be carried out just as though Greenport had again suffered sudden storm losses. Village officials, remembering how the real storm paralyzed their community, are cooperating by making this AOPA flight a part of the 300th celebration of the founding of the township of Southold.

The Greenport problem is to be set up on the basis of demonstration of the speed value of organizing relief by air. Pilots and planes will be called into swift action, nurses if needed, sources of supply of food and medicines located, and the whole project carried through exactly as a rehearsal of actual conditions of flood, hurricane, earthquake, or epidemic.

After the serious business of mobilization has been carried out, pilots will receive a free breakfast, swimming (300 feet from where the planes land) and a free boat ride on Southold Bay before the return flight to the home base is made.

AOPA "Air Guard"

A possible extension to the above plans may call for the formation of a corps of pilots to act as an "auxiliary to the Army reserve pilots." At the moment we are calling our tentative plan the "Air Guard." The AG, as we now visualize it, will in-

National Guardsmen affix parachutes bearing food and medical supplies under lower wing of biplane. AOPA Emergency Pilot Corps would perform similar duties in disasters.

clude a definite plan of training for AOPA pilots for which they will receive a special merit. Officers of the AOPA have been working on the problem for several weeks and have received the cooperation of and many suggestions from members of the Army Air Corps. Since conditions in the world are moving rapidly, it is possible that this plan will have been announced in full to AOPA members by mail before this column goes to press. A special uniform and appropriate personal and aircraft insignia are planned as a part of the organization of the AG. Pilots will have to pass certain qualifying courses of instruction which will probably be based on Air Corps requirements or modifications of military standards. This plan, if it goes into effect, will have the ultimate effect of a civilian air corps. Participation in the AG will be optional on the part of AOPA members. We suggest that all AOPA members read carefully the AOPA Section (received by members each month) for later developments as we "go to press" on the Section several days after this news column deadline.

Radio Development

Some few months ago we devoted two pages of the AOPA Section to a radio development of one of our members, Donald Mitchell. At that time we reported that our executive secretary, "Doc" Hartranft, had test flown the new set, a combination receiver, transmitter, and rotable loop antenna and had pronounced it as excellent for lightplane flying equipment. We are glad to announce that this set is now available to pilots and we understand that the final market price for the production model is $169.00. This price includes everything necessary to put the complete unit into immediate operation. We understand that installation is very simple and inexpensive and that the weight of the set allows installation without having a weight and balance test run in the majority of cases. Mr. Mitchell, in our opinion, is due a great deal of credit and we imagine that many owners will now be able to afford two-way radios in their ships for the first time. The set, we neglected to say, is being manufactured by Don's company, the Motorola Radio Corporation, and is available to a number of dealers throughout the country. The national distributor is located at Roosevelt Field, Mineola, N. Y. AOPA will be glad to give further information to those interested if they will drop a postcard to us.

Individual Hangars

For many weeks AOPA collected information from the manufacturers of the individual or T-shaped hangars, hoping that we could find one that would answer the purpose—and the pocketbook of the *average* owner or operator of non-schedule flying equipment. After viewing the results of some 23 companies we came to several conclusions. In the case of steel hangars, we found that the prices were usually too high. A man who purchases a $1,400 airplane is not going to turn around and spend that much on a hangar. Some will, of course, but we are talking about our average member.

Besides this, the cost of transportation of a prefabricated hangar—or even the materials for one—multiplied in astronomical

(*Continued on page* 91)

Introduce New Exhaust Silencer

EDDY LATULIPPE of Montreal, Canada, has invented an exhaust silencer which is radical in design. The device, which is demonstrated by Latulippe in the accompanying pictures, has been installed on a plane powered with a 200 h.p. engine. The silencer ranges in weight from eight to 23 pounds depending upon the engine horsepower. The muffler is made blow-out proof through use of a trap door which opens automatically in event of a backfire. A foot pedal enables the pilot to open or close the trap door. Engine noise is cut 70 per cent.

"Somewhere in England"

RUSHING production to meet the German airpower, Bristol *Blenheim* bombers are being produced *en masse* at this plant below, location of which is an Air Ministry secret. These *Blenheims* are powered by two Bristol *Mercury* nine-cylinder radial engines giving the ship a top speed of 295 m.p.h. Range of the bomber, since new wing tanks have been added, is given as 1,900 miles at about 220 m.p.h.

AIRCRAFT

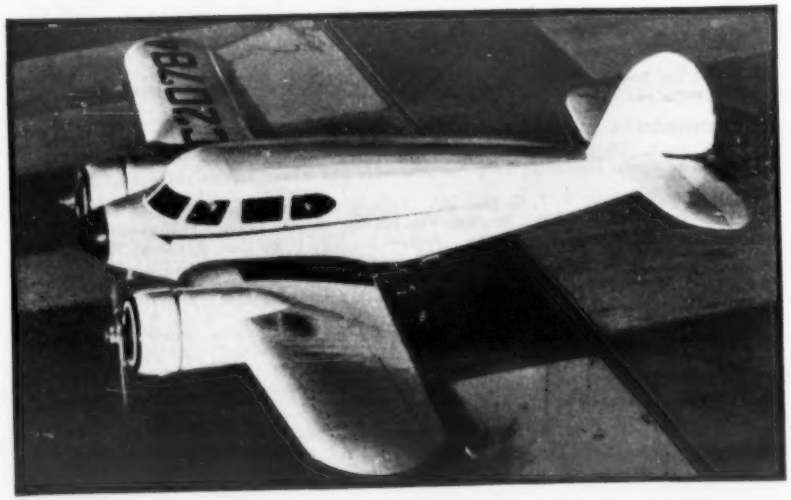
BEECHCRAFT
F17D

Beech Aircraft Corporation — Wichita, Kansas

BEECHCRAFT
18S

Beech Aircraft Corporation — Wichita, Kansas

AIRCRAFT



CESSNA
T-50

Cessna Aircraft Company — Wichita, Kansas

AIRCRAFT

HOWARD
DGA-15P

Howard Aircraft Corporation — 5301 W. 65th St., Chicago, Illinois

BEECHCRAFT 18S

COSTS: List price: $54,750. Minimum down payment: $20,628. Annual insurance premium: $5,475. Operating cost per hour: $50.22.

PERFORMANCE: Miles per gallon of fuel: 5.2. Cruising speed at 62½% horsepower: 220 m.p.h. Maximum speed at 12,000 feet: 230 m.p.h. Stalling speed: 61 m.p.h. Cruising range (excluding 10% fuel reserve): 1,000 miles. Service ceiling: 27,000 ft.

SPECIFICATIONS: A. T. C. No. 710. Type of airplane: CLM. Type of construction: metal, fabric. Engines: Two 450 h.p. Pratt & Whitney Wasp Jr. Fuel capacity: 210 gals. Weight empty: 5,031 lbs. Weight loaded: 7,500 lbs. Span: 47 ft. 8 in. Height: 9 ft. 5 in. Length: 34 ft. 3 in. Wing area: 347.5 sq. ft. Wing loading: 21.5.

ACCOMMODATION: Number of seats: 8 (including 2 pilots). Baggage: 900 lbs.

EQUIPMENT: Instruments (standard on this model): clock, sensitive altimeter, airspeed indicator, tachometers (2), ammeter, composite engine gauges (fuel pressure, oil pressure and oil temperature), turn and bank indicator, compass, vertical speed indicator, head temperature gauges (2), manifold pressure gauges (2), gas gauge, temperature gauge with 4-way selector switch for carburetor, outside and cabin air temperature, vacuum regulator, fuel pressure warning light, elevator tab position indicator, flap position indicator, cabin door ladder, folding wing walks, engine tools, high pressure air pump, jack pads, sling fittings.
Interior fittings: first aid kit, log books, cabin heating and ventilating system, individual adjustable chairs for pilots and passengers, toilet in separate compartment, interior curtains, individual reading lights, ash trays.
Propellers: Hamilton Standard, constant speed.

SPECIAL FEATURES: retractable landing gear and tail wheel, electrically operated (with auxiliary hand control), trailing edge wing flaps (electrically operated), dual pilot's controls, two mixture analyzers, two landing lights (retractable), flares. Available as sea- or ski-plane.

HOWARD DGA-15P

COSTS: List price: $19,885. Minimum down payment: $6,621.70. Annual insurance premium: $1,988.50. Operating cost per hour: not available.

PERFORMANCE: Miles per gallon of fuel: 7.7. Cruising speed at 75% horsepower: 192 m.p.h. Maximum speed at 6,000 feet: 201 m.p.h. Stalling speed: 61 m.p.h. Cruising range (excluding 10% fuel reserve): 1,150 miles. Service ceiling: 21,500 ft.

SPECIFICATIONS: A. T. C. No. 717. Type of airplane: CLM. Type of construction: metal, wood, fabric. Engine: 400 h.p. Pratt & Whitney Wasp Jr. Fuel capacity: 150 gals. Weight empty: 2,700 lbs. Weight loaded: 4,350 lbs. Span: 38 ft. Height: 8 ft. 5 in. Length: 24 ft. 10 in. Wing area: 210 sq. ft. Wing loading: 20.7.

ACCOMMODATION: Number of seats: 5. Baggage: 125 lbs.

EQUIPMENT: Instruments (standard on this model): altimeter, air temperature gauge, airspeed indicator, rate of climb, compass, clock, turn and bank indicator, venturi and pitot, flap position and stabilizer indicator, thermocouple, manifold pressure gauge, fuel pressure gauge, oil pressure gauge, oil temperature gauge, tachometer, carburetor temperature gauge, fuel gauge, ammeter, fuel selector switch, fuel analyzer, inertia starter.

Propeller: Hamilton Standard, constant speed.

SPECIAL FEATURES: electrically-operated spring loaded flaps, tripod landing gear with oleo and springs for taxiing, full swiveling, steerable, locking tail wheel, stainless steel firewall in front of power section, pressure fire extinguisher.

BEECHCRAFT F17D

COSTS: List price: $13,980. Minimum down payment: $5,592. Annual insurance premium: $1,363.05. Operating cost per hour: $14.08.

PERFORMANCE: Miles per gallon of fuel: 10.7. Cruising speed at 75% horsepower: 182 m.p.h. Maximum speed at 10,000 feet: 187 m.p.h. Stalling speed: 46 m.p.h. Cruising range (excluding 10% fuel reserve): 680 miles. Service ceiling: 18,000 ft.

SPECIFICATIONS: A. T. C. No. 689. Type of airplane: CLB. Type of construction: metal, wood, fabric. Engine: 330 h.p. Jacobs L-6. Fuel capacity: 76 gals. Weight empty: 2,155 lbs. Weight loaded: 3,550 lbs. Span: 32 ft. Height: 8 ft. Length: 25 ft. 11¼ in. Wing area: 296.5 sq. ft. Wing loading: 11.97.

ACCOMMODATION: Number of seats: 5. Baggage: 125 lbs.

EQUIPMENT: Instruments (standard on this model): turn and bank indicator, vertical speed indicator, airspeed indicator, altimeter, compass, tachometer, manifold pressure gauge, fuel pressure gauge, oil pressure gauge, oil temperature gauge, 30 ampere ammeter, tab position indicator (electric), gasoline gauge (electric, with selector switch), two Moonglow projector type instrument lights, set of navigation lights, complete radio bonding and shielding.
Propeller: Hamilton Standard, controllable pitch.
Interior fittings: cabin heating and ventilating system, cabin soundproofing, throw-over control column.

SPECIAL FEATURES retractable landing gear and tail wheel (electrically operated, with auxiliary hand control), electrically operated trailing edge flaps on lower wings, negative wing stagger, full vision curved safety glass windshield. Available as sea- or ski-plane.

CESSNA T-50

COSTS: List price: $28,000. Minimum down payment: $9,335. Annual insurance premium: $2,688. Operating cost per hour: $30.35.

PERFORMANCE: Miles per gallon of fuel: 6.6. Cruising speed at 75% horsepower: 191 m.p.h. Maximum speed at sea level: 195 m.p.h. Stalling speed: 55 m.p.h. Cruising range (excluding 10% fuel reserve): 713 miles. Service ceiling: 22,000 ft.

SPECIFICATIONS: A. T. C. No. 722. Type of airplane: CLM. Type of construction: metal, wood, fabric. Engines: two 225 h.p. Jacobs L4MB. Fuel capacity: 120 gals. Weight empty: 3,500 lbs. Weight loaded: 5,100 lbs. Span: 41 ft. 11 in. Height: 9 ft. 11 in. Length: 32 ft. 9 in. Wing area: 295 sq. ft. Wing loading: 17.3.

ACCOMMODATION: Number of seats: 5. Baggage: 350 lbs.

EQUIPMENT: Instruments (standard on this model): compass, sensitive altimeter, airspeed indicator, tachometers (2), fuel gauges (2), combination oil pressure, temperature and fuel pressure (2), manifold pressure (2), fuel analyzers (2), volt-ammeter, turn and bank, rate of climb, head temperature with selector, carburetor air temperature, clock.

Propellers: Hamilton Standard, constant speed.

Interior fittings: foam rubber cushions, arm rests, assist cords, parcel shelf, heating and ventilating system, soundproofing.

SPECIAL FEATURES: electric landing flaps and retractable landing gear, landing lights, shielding and bonding, Moonglow instrument lighting, locking swivel tail wheel, hydraulic brakes, dual controls, Plexiglas windshield and windows. Also available as a seaplane or skiplane.

STUDYING AERODYNAMICS BY KITE

by RAOUL J. HOFFMAN

FLYING a kite has been accepted as a recreation for youngsters. However it may be used for finding aerodynamic characteristics without the use of a wind tunnel. This method will give the aviation student a simple and practical application of the mathematical problems used for finding the lift, drag, center of pressure and stability factor of an airplane model. The tests however will not conform to the results from a wind tunnel.

Scientific testing of large kites was employed by the pioneers of aviation to find not only the aerodynamic characteristics but also the correct structural details for a proposed man-carrying glider. Such systematic research was made by the Wright brothers before attempting to build their first successful airplane.

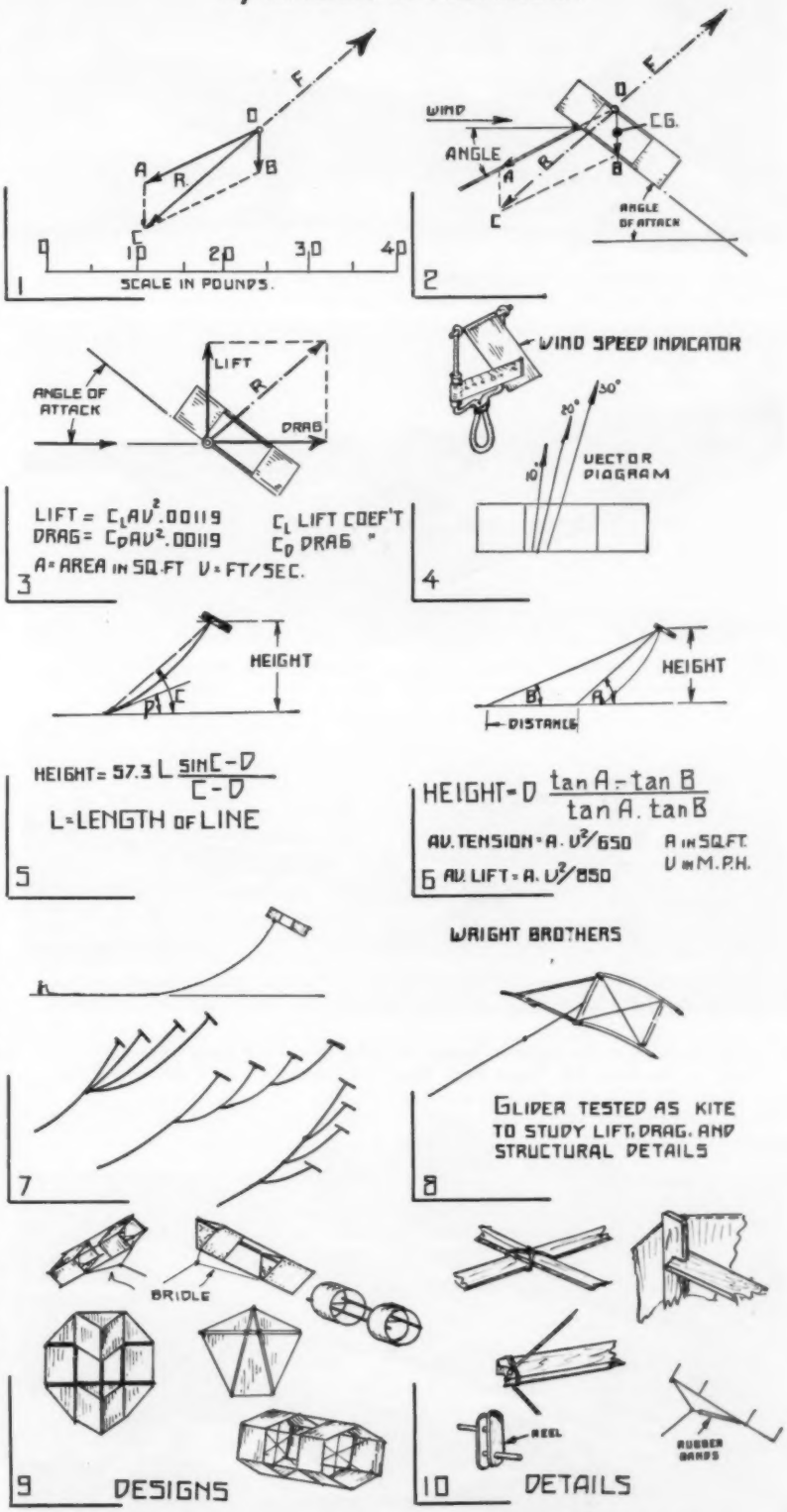
To eliminate some of the mathematical operations the graphic representation of forces and resolution of a force into components should be used. Section 1 shows how the resultant R is found of the two forces O-A and O-B. The magnitudes of the forces are taken from the scale in the same section. O-A is 15 pounds and O-B is five pounds. Parallels are drawn through points A and B. Their intersection point C connected with O is the resultant (R) of the two forces. Adding a force F equal to the resultant R but opposite in direction will balance the two forces and the system of forces is in equilibrium.

This graphic method is applied to find the air force of a kite as illustrated in Section 2. For laying out the forces the weight of the kite and the location of its center of gravity must be known. The tension on the line is obtained with a spring scale; the angle of the line with the ground and the angle of attack is measured by sighting with a protractor and a plumb line. It is assumed that the wind is parallel with the ground.

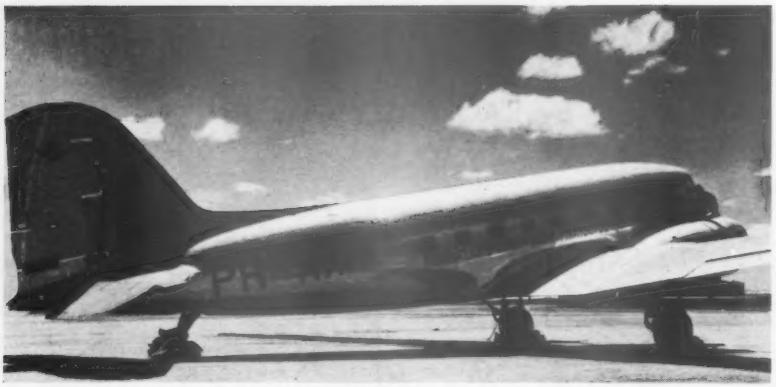
The sketch shows the kite with the angle of attack. A vertical line is drawn through the center of gravity and a line through its attaching point. The intersection of the center of gravity line and the kite line is the point O. O-A denotes the weight of the kite and O-B the tension of the line laid out to any scale. Parallels drawn through A and B gives an intersection point C. Then O-C is the resultant R of the weight and tension. The opposite force F equal in magnitude to R is the total air force on the kite.

In most technical reports the aerodynamic characteristics of airfoils and models are given by their lift and drag forces which are the vertical and horizontal components of the resultant of all air forces. In Section 3 the resolution of the resultant R into two components is illustrated. To get the two components horizontal and vertical lines are drawn as indicated and their lengths are the magnitudes if measured on the same scale the resultant was drawn. The length of the vertical is the lift and the length of the horizontal the drag of the kite. In Section 3 two basic formulae are given in which A denotes the

(*Continued on page* 87)



Through diagrams like these the Wright brothers studied balance of a glider.



Invasion of Holland by Germany halted this Douglas DC-3 as it was being flown east for shipment to KLM. United Air Lines bought it and is converting it for service.

An all-metal fuselage and aerodynamically clean lines feature the new sailplane that was designed and built by Aero Industries Technical Institute students' soaring club.

Being delivered to the Army Air Corps for use in its expanded pilot training program is Vultee's BT-13. Blind flying hood may be rigged on either front or rear cockpits.

Lined up below at the Stearman factory, Wichita, Kan., are primary trainers (front to rear) for the Army Air Corps, Brazil, Cuba and Venezuela. U. S. trainer is PT-13B.

Neils Arntzen, Ruthton, Minn., celebrated his 90th birthday with his first plane ride.

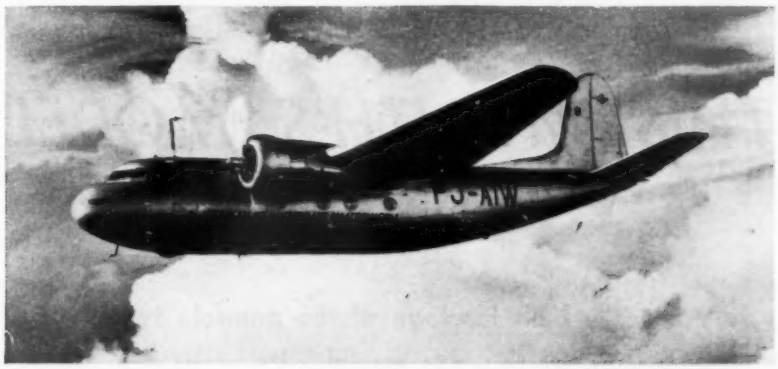
Army flyers dropped flashlight bombs to get a night picture of Maxwell Field, Ala.

Ninety-six inches high, this big tire is to be used on the Army's huge, new B-19.

Currently in production for U. S. Marines is new Douglas SBD-1. Note wingtip slots. Navy version is BT-2.

Newest Navy fighter undergoing tests is this Bell XFL-1, a conventional version of the Army's "Airacobra." The 1,200 h.p. Allison is behind the pilot.

HAVE YOU SEEN ?

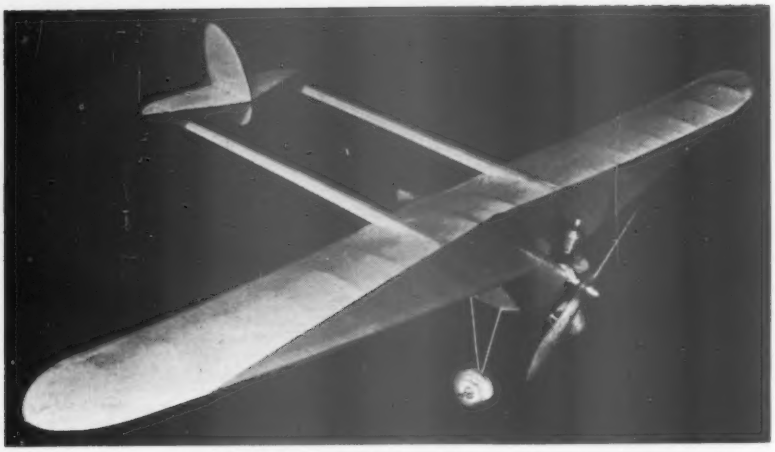


Latest model of the Douglas DC-5 has been delivered to the Dutch KLM line for use in South America. It has two 1,000 h.p. engines, new tail, slots and tricycle gear.

With the domestic airlines going in for more and better color schemes, United has adopted that above for its Douglases and Boeings. Colors are red, white and blue.

A Grand Rapids, Mich., operator made a plane dolly from old automobile parts.

U. S. Navy reserve aviation base at Floyd Bennett Field, New York, uses truck and propeller-tip sleeve to turn over balky engines. Regular shock cable rope is used.



Ready for many fine flights, the completed model's unusual design draws attention.

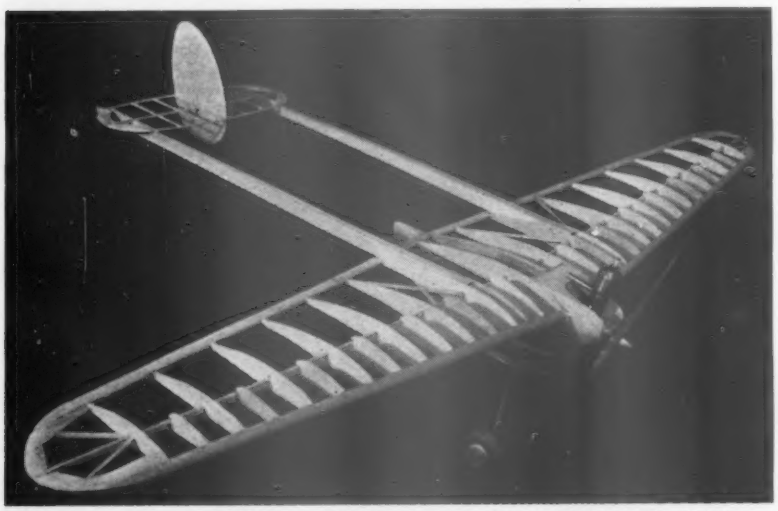
THIS MONTH'S MODEL

by PAUL W. LINDBERG
Model Editor and Designer

An easily built fuselage of the gondola type is a feature of this gas model. Its wings are of full cantilever construction. An efficient flyer.

ITS motor purring at two-thirds throttle, the model takes off in a flash and starts to climb. The climb is steady and steep as altitude is the main objective to insure a maximum amount of gliding time. It levels off and then swings out in a long, graceful angle.

That is what you can expect to see done efficiently many times after you have constructed this month's model. Designed to save the builder many hours of work, the model has a simplified plan which will facilitate construction. Building time is saved particularly in the fuselage design. Another of the model's features is the full cantilever construction of the wing. By increasing the plans four times the size shown, you will have a model identical with the one we constructed.



The motor bearers are of hard wood while the rest of the model is built of balsa.

Construction of Fuselage

Careful study of the plan before construction is begun will assist materially in reducing the hours necessary for turning out this unusual fuselage. The fuselage, it will be noted, resembles a gondola in design. Formers are made from ⅛-inch sheet balsa. Vertical members are ⅛-inch square balsa. The stringers are $\frac{1}{16}$x⅛ inches. Ends of the stringers to be placed at the front of the fuselage must be soaked in water and shaped because of the abrupt curve at that point in the design.

It is easiest to attach the stringers by placing the finished cross-sections of the fuselage top-side down on a flat surface. Motor bearers should be made of a hard wood and cemented securely in place. The balsa cowling may prove difficult but patient work will yield a good job.

Wings and Tail Assembly

The wings should be built in two separate panels on a flat surface. When completed, block the tips up until there is a dihedral of four inches. Then glue the center section in place, reinforcing heavily. A few ⅛-inch square balsa strips may be added along the wing for additional strength.

The tail booms should be of a strong grade of balsa, preferably $\frac{1}{16}$-inch sheet basswood. Spacers are placed along the boom to strengthen the assembly. Sand the corners of these to a small radius, as shown in the cross section plan, and apply several coats of dope for more strength.

The rudder is made of solid balsa of medium weight. Do not attach it to the elevator until the latter has been covered and painted.

Covering the Model

A good grade of bamboo paper should be used for covering the model. Ordinary airplane cement, thinned 30 per cent, makes an excellent adhesive for attaching the paper to the frame. Cover the space between each stringer of the fuselage to make the covering uniform and to eliminate wrinkles.

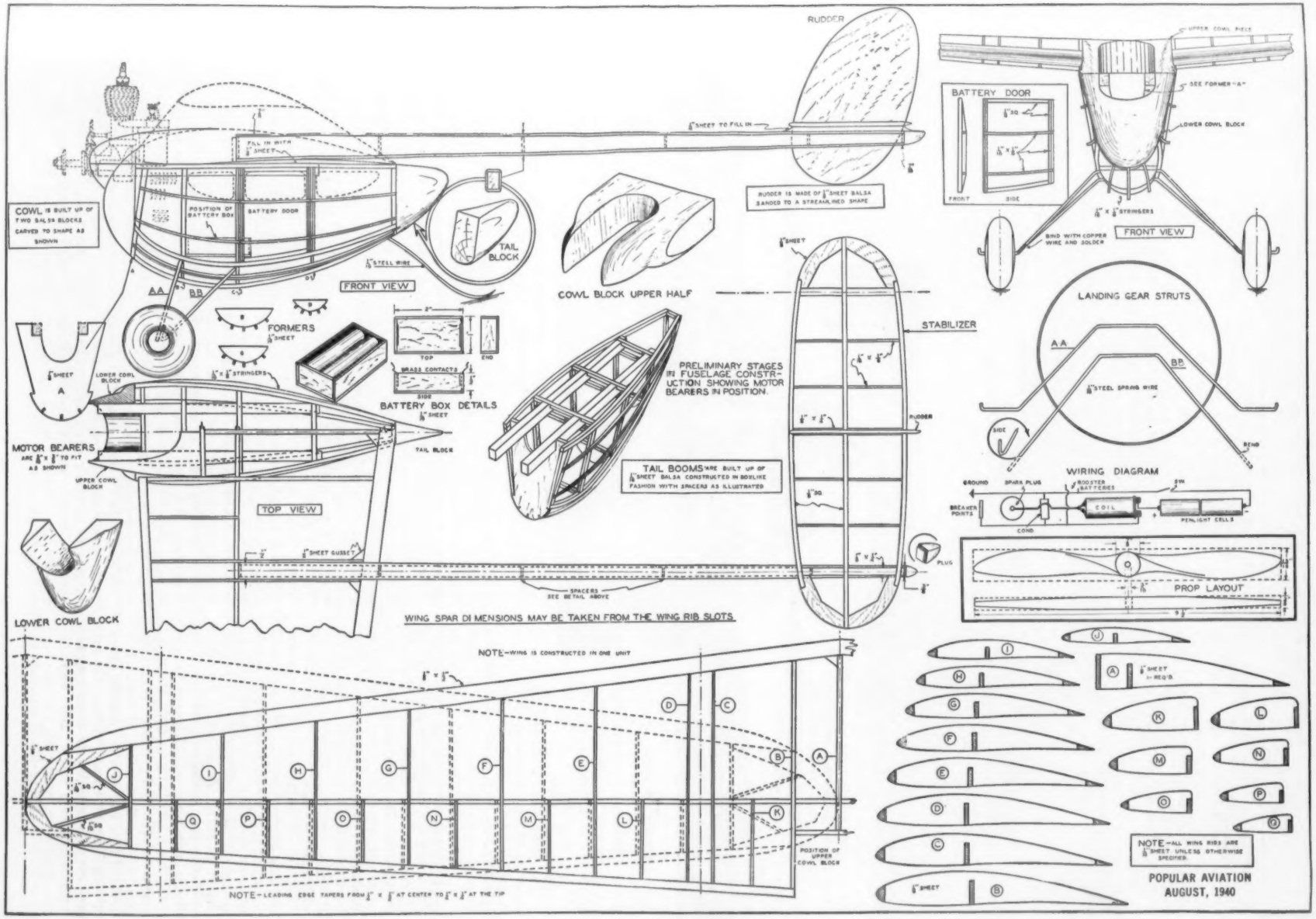
Water is used to shrink the paper to drum-like tautness. When covering the wings, apply the paper to half the wing, wet it for shrinking, then pin the wing down on a flat surface to prevent warping while it dries. Repeat this operation for the other half of the wing.

Airplane cement, diluted 50 per cent with thinner, makes an excellent dope. Use at least three coats on all covered parts, sanding each coat before applying the next. Colored coats should be added last.

Assembly

Wiring and motor installation are explained in the plan. Details of assembly also are indicated. All parts should be lined up perfectly and checked with the plan. Care should be taken in testing the model to insure the many fine flights it is capable of making for you.

END


RUDDER
SHEET TO FILL IN
RUDDER IS MADE OF SHEET BALSA SANDED TO A STREAMLINED SHAPE
COWL IS BUILT UP OF TWO BALSA BLOCKS CARVED TO SHAPE AS SHOWN
FILL IN WITH SHEET
POSITION OF BATTERY BOX
BATTERY DOOR
TAIL BLOCK
STEEL WIRE
FRONT VIEW
AA
BB
FORMERS
SHEET
A
LOWER COWL BLOCK
STRINGERS
MOTOR BEARERS
ARE TO FIT AS SHOWN
UPPER COWL BLOCK
TOP VIEW
SHEET GUSSET
LOWER COWL BLOCK
COWL BLOCK UPPER HALF
TOP
END
BRASS CONTACTS
SIDE
BATTERY BOX DETAILS
SHEET
PRELIMINARY STAGES IN FUSELAGE CONSTRUCTION SHOWING MOTOR BEARERS IN POSITION.
STABILIZER
RUDDER
PLUG
TAIL BOOMS ARE BUILT UP OF SHEET BALSA CONSTRUCTED IN BOXLIKE FASHION WITH SPACERS AS ILLUSTRATED
SPACERS SEE DETAIL ABOVE
WING SPAR DIMENSIONS MAY BE TAKEN FROM THE WING RIB SLOTS
NOTE—WING IS CONSTRUCTED IN ONE UNIT
SHEET
POSITION OF UPPER COWL BLOCK
NOTE—LEADING EDGE TAPERS FROM AT CENTER TO AT THE TIP
UPPER COWL PIECE
SEE FORMER "A"
LOWER COWL BLOCK
BATTERY DOOR
FRONT
SIDE
STRINGERS
BIND WITH COPPER WIRE AND SOLDER
FRONT VIEW
LANDING GEAR STRUTS
AA
BB
STEEL SPRING WIRE
SIDE
BEND
WIRING DIAGRAM
GROUND
SPARK PLUG
ROOSTER BATTERIES
SW
BREAKER POINTS
COIL
COND
PENLIGHT CELLS
PROP LAYOUT
SHEET
NOTE—ALL WING RIBS ARE SHEET UNLESS OTHERWISE SPECIFIED
POPULAR AVIATION
AUGUST, 1940

Crushing America by Air

(*Continued from page* 11)

of projectiles, air torpedoes, bombs, gas projecting apparatus and guns. Suppose this force were launched at Chicago with 2,000 tons of projectiles. They would make the trip in seven hours *(about three hours today.—Ed.)*. They could not only force the evacuation of the city and set on fire all the towns and manufacturing plants around Chicago, but could throw gas over the fields where cattle and other livestock lived, destroying all of them. They could drop chemicals on the fields which would destroy all vegetation and even prevent their use for agriculture for a considerable time. The gas would affect all water supplies, even rivers and lakes. The result of such an attack would be absolutely decisive. The armies would be powerless to avert it and nothing could stop it except other airplanes taking the offensive against the enemy at the same time.

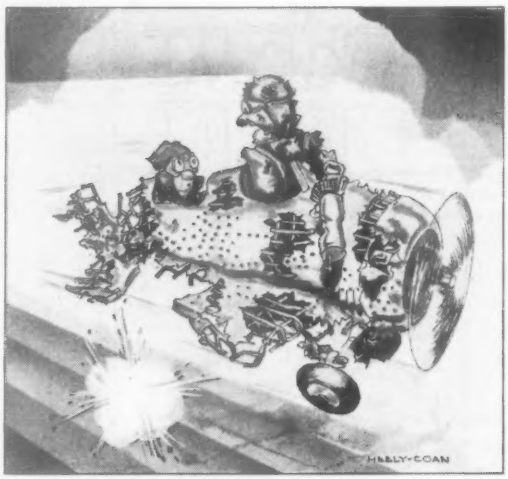
The old services put up a howl that this kind of war is inhumane, but can anything be worse than the long protracted torture to which armies and peoples are exposed when a war is carried on in the present accepted fashion? Air power will get a quick decision. The mere threat of its use may be sufficient to force a peace.

Let us suppose that war occurs between a nation on a continent such as Europe, and one situated on an island or series of islands, such as England or Japan. Both these empires depend almost entirely for their existence on their overseas commerce. As most of their people have been called into the industrial centers to manufacture goods which they sell, there are very few left for the production of food and the necessities of life.

Great Britain is a direct descendant of the Phoenician system. This comprises a series of armed ports throughout the world into which the raw materials of the various countries are gathered. These materials are picked up, put into boats and transported to Great Britain where they are manufactured into articles of trade and then distributed to the world from ships. To break down these trade routes at any place, for instance, the English trade routes through the Mediterranean and the Suez Canal, would be her downfall. Similarly, the breakdown of the trade routes through the China Sea and the Straits of Malacca would have a corresponding effect on Japan.

Air power is entirely capable of breaking down these lines of communication by sinking the ships and causing the evacuation of the ports. An attack by air power on islands such as those comprising Great Britain and Japan would be decisive because the people have no place to go and nowhere to get food except on these comparatively small stretches of land. It is doubtful if a two months' reserve supply of food exists in Great Britain. The targets are well defined, easy to pick up and tremendously easy to hit. Both these nations thoroughly realize this and both have organized great air forces which are entirely independent of the Army and Navy and are charged specifically with the defense of all the air over their respective countries, and with making air attacks against enemy countries.

In all the leading countries air, land and water are under independent ministries, which are brought into one organization, either a department of national defense with a secretary or minister at its head, or under a committee that handles the whole war-making system of the state. In this way coordination is secured and each branch of the service has its own voice in the scheme. In England, the Air Commander has charge of all defense arrangements for the British Isles in case of war and the actions of the army and navy within 200 miles of the coast will be coordinated under his direction. In other words, the head airman is the supreme commander of all forces in case England is attacked.



"Aw, what are you beefing about? . . . We haven't run out of gas yet, have we?!"

I mention England, particularly, because they received very heavy casualties and damages from aircraft bombs during the war, which brought home to them the realization of what would happen in another war. England started in the World War with an Army Air Service and a Navy Air Service, just as we have in the United States now. When the German airplanes raided England the Army Air Service would chase them to the shores of the sea, at which point they would have to turn around and go back. The Navy Air Service was then supposed to take up the pursuit but they were never there, so the result was that the Germans got away safely. The British soon put a stop to this state of affairs by creating a Ministry and an Independent Air Force.

In the United States today there is an indescribable mess about the defense arrangements all along our coast and in the interior. Nobody knows who has charge of anything. There is no air commander and no similarity of instruction between the Air Services of the Army, Navy, Marines or Coast Guard. There is no air force whatever.

From the Navy we have heard a great hue and cry about the Washington Conference for the Limitation of Armaments, brought about in 1921, and how adversely it affected the United States. The fact is that nothing in the history of the world has done more toward the reduction of useless and expensive armaments than the calling of this conference by Secretary of State Hughes during the Harding administration and the results it obtained. It has saved millions for the taxpayers of all the countries involved and has shown people what can be done under certain conditions with an accord between different nations on the subject of disarmament. The influence of air power had much to do with this.

It will be remembered that we sank the battleships with airplanes in peacetime tests in 1921, a few months before the Limitations of Armaments Conference was called by the United States. The board of Army and Navy officers headed by General Pershing that witnessed these tests put in their findings:

"Aircraft carrying high-capacity, high-explosive bombs of sufficient size have adequate offensive power to sink or seriously damage any naval vessels at present constructed, provided such projectiles can be placed in the water close alongside the vessel. Furthermore it will be difficult, if not impossible, to build any type of vessel of sufficient strength to withstand the destructive force that can be obtained with the largest bombs that airplanes may be able to carry from shore bases or sheltered harbors."

This finding had a distinct bearing on the Conference for the Limitation of Armaments. The Navy flooded the country with propaganda that it seriously crippled our national defense. As a matter of fact, it made us much better off because the ships that we were building not only were surface battleships completely at the mercy of airplanes but even at that they were to be equipped with 16″ guns, whereas the British had ships projected to carry 18″ and 20″ guns and the Japanese would have followed the lead of the British. They would have waited until we had built a lot of old tin ships with obsolete armaments, then they would have come out with new and improved ships and we would have had to repeat the performance of building and catching up with their advancement. As long as the leading maritime nations can encourage us to build a navy and keep down our air force they have a great advantage, because they are creating huge air forces that will be effective while we neglect the development of our air force and continue to build warships which are vulnerable to attack by bombing planes.

The same conditions continue here. Our country was flooded with Navy propaganda about building cruisers, during the last winter. Incidentally, the air people were not allowed to flood the country with air propaganda about how easily these things

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. . . because it is *Cruising Range* that makes a Cross-Country Airplane

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Here's how the Piper Coupe compares with other leading makes of light airplanes on a 600-mile cross-country trip:

Airplane	Average Speed	Range*	Maximum Gas Capacity	Refueling Stops**	Elapsed Time
Piper Coupe	95	411	25	1	6 hrs. 50 min.
Plane A	97	161	12	3	7 hrs. 41 min.
Plane B	97	254	17	2	7 hrs. 7 min.
Plane C	102	260	15	2	6 hrs. 54 min.

*Allowance has been made for one-hour reserve gas supply at a rate of consumption of 4½ gallons per hour.

**Allowance for 30 minutes is made for each refueling and it is considered, ideally, that all refueling stops are directly on the line of flight.

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See the Piper Cub Exhibits at Both of the World's Fairs

could have been sunk and how, if the money were applied to the construction of commercial and military aircraft, a much greater asset for the defense of our country would be obtained. This state of affairs exists because we have no separate department of aeronautics and the Navy and Army either prohibit all propaganda about air power or distort the truth about it.

The Navy, with their lobby in Washington, pushed a provision through Congress for cruisers. These cruisers are steam vessels capable of cruising about 10,000 miles at 13 knots and carrying 8" guns. The paper and ink had hardly dried with the President's signature to this appropriation act, when it became known that the Germans already had in existence a 10,000 ton cruiser capable of going 10,000 miles at 20 knots, carrying six 11" guns in triple turrets with mountings permitting a very high angle of elevation and eight 5.9" guns behind shields. This ship also carries six 19.7" torpedo tubes on triple carriages, one at each side of the quarter deck. The big guns of this vessel have a loading gear of a new pattern which enables a very rapid rate of fire to be maintained. Their range is 30,000 yards. This ship is driven by internal combustion oil engines which are said to weigh only 17½ pounds per horsepower. One of these German cruisers could stand off and whip the whole force of steam cruisers that the United States authorized last winter. Not only can this single German ship defeat them any place it can find them but it can sail across the Atlantic a couple of times and do it.

What absolute bone-headedness has been displayed! How utterly inefficient the national defense system is which will allow such a condition to exist. The American people have no knowledge of how they are being duped by the Navy Department in Washington and the people who sell coal, steel and supplies to the Navy. The cruisers authorized have no value whatever in national defense. Have we stopped the building of these worthless vessels and adopted types superior to anything else? No, we go ahead spending billions and all the Navy says is that we must limit the Germans so that they cannot build such ships!

Good submarines are extremely necessary—but our submarines are the worst in the world and as long as it is left to such an organization as our present Navy Department to perfect them, we shall never have good ones.

At the present time we spend about one-third of our total national income in arrangements for national defense or payment of past wars. Of the amount actually appropriated for military purposes the Navy gets about 50 percent, the Army about 40 percent and the aviation, which is split up between the Army and Navy, about 10 percent. Even if the money for aviation were spent wisely—which it is not—it would go a long way, but so much is used up in useless overhead and inefficient organization that the funds are largely wasted. The actual value of air power, the Army and Navy to a country might be stated as 50 percent for air power, 30 percent for the Army and 20 percent for the Navy. See how the appropriations are handled.

If the United States had a well organized air force, entirely independent of the Army and Navy, it would be completely immune from overseas attack. No ship could approach our coast across the Atlantic or Pacific Oceans in the face of a well-organized air force. The air force is the only thing that can go up in the air and fight hostile aircraft. It is the only force that can launch an attack against a foreign country, either north or south of us, or across the Atlantic or Pacific.

The stepping stones across the Atlantic are not as far apart as most people think. Going by way of Labrador, Greenland, Iceland and Scandinavia, or the various islands north of Great Britain, the greatest sea hop is less than 700 miles to our shores.

"Our blind flying instruments used so much space, there wasn't any room left to put in windows."

In 1923 I conducted some maneuvers with what aircraft we had left and what airmen remained of the efficient war-trained personnel, along the Atlantic coast to show what could be done with even the primitive aircraft we had then. Having received authority from Congress to have two battleships placed off Cape Hatteras, to be used as targets, I landed our small air force of 50 or 60 airplanes on the island of Hatteras. This strip of land is a sandy fringe along the Atlantic Ocean. It lies 30 miles from the mainland, a distance which no cannon could reach effectively. It is protected to the north and south by deep inlets. Hatteras Inlet on the south and Oregon Inlet to the north, across which an army could not move in the face of the most rudimentary of aircraft. I landed 2,000 pound bombs, 1,100 pound bombs and 600 pound bombs, and all supplies necessary for the operation of these aircraft, from vessels in the water. This was to show that aircraft could be supplied by submarines, if they used an island and held control of the air. We also landed supplies from aircraft to show that we could be supplied through the air. In the old days, before the advent of aircraft, we used to think that a small island was a dangerous place to be caught unless complete command of the sea were assured. But now aircraft can seize an island and operate from it without fear of interference by surface vessels, because they can sink them hundreds of miles away.

Submarines are the only seacraft to be feared and these are really a dangerous adversary, because they not only can rise to the surface and use guns of any size but they can launch aerial torpedoes and direct them by radio at objects on land. The best defense against submarines are other submarines and, after that, aircraft. The only thing that could dislodge aircraft from a position of this kind would be a hostile air force. This of course would lead to an air combat for control of the air.

From our air base on Hatteras, we flew out over the sea and sank the battleships. One 1,100 pound bomb sank the New Jersey in 4½ minutes, tearing the whole top of it off. The other vessel was sunk in seven or eight minutes, after a decisive hit was registered. Some of our airplanes flew 179 miles to make the attack which they launched from an altitude of 11,000 feet, securing around 60 percent of effective hits. The fire of great projectiles from aircraft is the most effective and the best directed fire we have ever known, as far as missile-throwing weapons are concerned. It is more accurate than cannon or rifle fire.

Having completed these tests and shown how an island could be used, I assembled our little air force the following day at Langley Field, Va., on the shores of Chesapeake Bay. The day following, I took these 60 ships (including some 25 of the logy old Martin bombers) and flew from Chesapeake Bay to Bangor, Me., landing in a field which we selected and which had never been used before by aircraft. This maneuver was executed not only to show how we could defend the whole coast of the United States from Maine to Florida in one day, but also to show how this same air force with which I landed at Bangor in the summer of 1923, having flown in one day from Chesapeake Bay, a distance of 700 miles, could have kept right on and gone to Europe. By putting auxiliary gas tanks into these planes, which would have weighed no more than the bombs we carried, the radius of action and operations for the planes would have been doubled.

Carrying out the same journey of 700 miles in the direction of Europe we could have gone the first day from Bangor to Cape North in Labrador; the following day to Cape Farewell in Greenland. The day after to Iceland and to either the Scandinavian peninsula or the British Isles. With these old wartime aircraft we could have gone right over to Europe! The following year, our Round-the-World flyers flew from Europe to America by the same short route. It is the one the ancient Norse mariners used when they went from Europe to America. With modern aircraft

(*Continued on page 63*)

THAT OUR NATION MAY ENDURE

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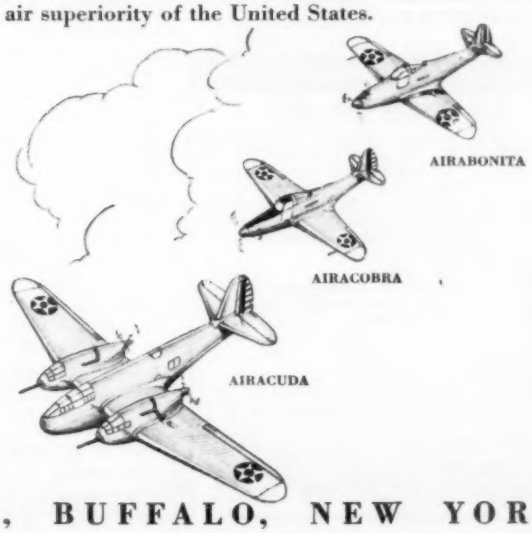

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Airy Chat

(*Continued from page 4*)

IF ever we've attended a top-notch aviation affair, it has been Steadham Acker's mad but gay four-day whirl at Birmingham. Last year at this time we mentioned the Acker hospitality. But this year, practically the whole aviation industry headed for the southern city which—even Birmingham natives must admit—ordinarily is no great shakes as an aeronautical metropolis. A whole plane-load of us (in a Pennsylvania-Airlines DC-3) flew to Atlanta, then Birmingham, from the National Aviation Forum in Washington. Our ship had no sooner landed on Acker's home grounds than we were whisked off to the first party. By the time we got aboard a special northbound TWA Douglas we had accompanied the aviation industry on an average of four and five parties and meetings for four days running. We're still trying to catch up on our sleep.

* * *

ANOTHER one of those last-minute "musts" that gives an editor the shakes was "Flivvers for the Allies" on page 33. Mr. Rand telephoned, one day after our deadline, to tell us that he'd just returned from the flight up to Halifax. We made him swear on his grandmother's lace curtains that he'd sit right down that moment and start writing. Meanwhile, after about a dozen phone calls and three telegrams, we located photographs. Then followed the usual mad rush from printer to engraver to pressroom—and you. But we knew our good luck wouldn't hold; we had no sooner gotten proofs of the finished magazine when the French (whose planes they were) announced they were giving up.

* * *

WHAT'S-IN-THE-WIND DEPARTMENT. That's a terrific wallop the C.A.A. has given Walter Beech; all single-engined Beechcrafts have been plastered with restrictions because of a series of structural failures . . . the C.A.A. limits the top speed of these ships to 160 m.p.h., though most of them normally cruise much faster . . . the C.A.A. also has prohibited instrument flying in them . . . Four Japs, each with a camera, were at the St. Louis airport the other day photographing everything in sight: airliners, Army planes and new buildings going up on the field . . . The Royal Canadian Air Force recently had a bad series of training accidents, all of them due to engine failure . . . the other day Canadian intelligence officers caught two R.C.A.F. officers putting lumps of sugar in the fuel tanks . . . a firing squad did the rest . . . TWA may make certain manufacturers pay for the recent forced landing of their new *Stratoliner* . . . TWA engineers had insisted the new airliner's carburetors weren't getting enough heat; the manufacturers said they were . . . three of the four carburetors iced up over Colorado, resulting in a belly landing in a field . . . damage: $20,000 . . . A pilot who used to fly tri-motored Fords told us of the time he unwittingly carried 31 South American soldiers, all of them standing in the cabin, on a flight . . . Newark's airport, now closed to airlines, may reopen again as United Air Lines' main overhaul base (now at Cheyenne, Wyo.) . . . understand UAL wanted the field at Bendix, N. J. . . . Four German reconnaissance planes recently photographed 400 miles of the British coast in 21 minutes . . . The Barkley-Grow airplane company has been bought out by the Aviation Manufacturing Corporation (Stinson, Lycoming, Vultee) . . . There's the story that a French, British and Turkish purchasing mission recently played cards to see who would get the first 1,000 warplanes built by a certain eastern manufacturer . . . the French won . . . a certain dashing movie actor and flyer, recently had his license yanked, then returned, after a crackup . . . When the landing gear of an airliner collapsed at LaGuardia Field recently, Mayor LaGuardia himself rushed out on the field, ordered the airport closed and banned all newspapermen—including a publicity man of the airline involved . . . Please excuse the slip in the June P. A.; Barbara Kibbee is *not* the daughter of Movie Actor Guy Kibbee . . . The address of the organization described in "Cloud Club" in the June issue is Cloud Club, Inc., St. Paul Municipal Airport, St. Paul, Minn. . . . in case you wrote them and got your letter back . . . A passenger aboard a sleeper plane recently had a few trying moments locating a pair of shorts . . . when the ship stopped for a few moments at Nashville, Tenn., the stewardess joined the search . . . she recalled having mislaid them . . . suddenly a dainty arm poked out from between the curtains on an upper berth . . . between the thumb and forefinger of lovely Madeline Carroll, the film actress, hung the shorts. . . .

* * *

THE July issue will hold a prominent place of distinction in our memory for some time to come. First came Robert A. Winston's letter on his observations in the wars overseas; it tied in beautifully with the Belgian Brewster fighter on the front cover. Meanwhile, the lead-off article in the same issue was "Is Italy an Aerial Threat?" That issue went on sale throughout the country on June 7. On June 10 Mussolini declared war on the Allies.

* * *

JOHN B. RATHBUN died on June 11. Like all good editors, J.B.R. or The Skipper, as we knew him, died "in harness." One of the earliest American flyers, he had been in aviation almost as long as the Wright brothers. His hundreds of books and magazine articles on aviation were among the most authoritative available. For almost 10 years he served as POPULAR AVIATION'S editor. The aviation industry, as well as this magazine, has lost a valuable leader.

* * *

CUTAWAY drawings, an old British custom, always intrigued us. For more than a year we tried—somewhat half-heartedly, we'll admit—to find a draftsman able to handle the job with a minimum of effort. One day not long ago we finally found the solution—in our own art department. His first effort appears on page 45. We're currently trying to lure him away from his regular duties to start work on our next drawing.

* * *

We'll keep you posted. M.K.

END

(*Continued from page* 60)

this route can be used, islands seized and occupied as air bases easily. Airplanes capable of going 300 m.p.h. can span this distance in a day.

An even closer bridge exists to Asia. There are only 52 miles of water separating Alaska from Siberia. It is along these lines that future invasions will come because they are the shortest lines using comparatively small islands for their bases of operations and striking directly at the great vital centers, cities and transportation lines.

The United States is the most continuously self-contained country that the world has ever seen. In case of war, it can easily exist without ocean-borne commerce. We raise everything that is absolutely essential to our maintenance and supply. Therefore, even if a Navy were effective as a means of controlling a sea, it would have comparatively little to do for us because we can very easily get along without it. Countries such as England or Japan are unalterably tied to their sea lanes of communication for existence. We in this country are the least tied to them of any nation on earth.

By this I do not mean that we should not develop our merchant marine to the greatest limits possible for the purpose of distributing our goods to the four corners of the earth. I am one who believes in direct government assistance to our merchant marine. But why should we pile money into a navy which can bring us the least advantage of any of our three elements of defense, air, land and water—and leave an air force totally unprovided for, and the poor struggling air development tied to the tail of the Army, Navy and Commerce Departments? Do the Army and Navy give any consideration to the avenues of approach and attack by aircraft as I have outlined above, from Europe or Asia? They do not. These things were not done hundreds of years ago, they cannot be found in the pages of some old musty volume and then copied and modified a little bit to meet existing needs. In this day, constructive minds can employ the armed forces of a nation and bring about strategical results which would lead to world empire. If Germany had known the power of aircraft and the submarine at the beginning of the European War as they are known today she certainly would have had world empire *(note well this shocking prophecy.—Ed.)*. All of this knowledge has come about in the last 10 years. It is just as absurd to match an army and navy against air power as it was for the slow heavy-armored infantry of Europe to oppose the mounted horsemen of Genghis Khan, the Tartar.

It is interesting in passing to note how Genghis Khan operated. To begin with, his men were inured to hardship. Their clothing consisted of sheepskins. If they were put to it they could kill a sheep, take off the bloody skin, turn the wool in toward their bodies and sleep in a snow drift. Each man had three horses, riding one and leading two; usually these were mares in milk. They drank the milk and when they stopped, they would dry it and carry it with them. If pressed too severely, they killed a mare and ate the meat. By riding three animals, they could cover 80 miles a day. They always had their food and lodging with them and depended on no base of operations. They were armed with bows and steel arrows so powerful that they could pierce a corselet of the finest armor. Their men were divided into three categories: some carrying lances, using oxhide armor to protect themselves; others carrying swords and others arrows of three kinds, one for killing animals, one for killing unarmed men and one for piercing armor. When they attacked the slow, sleepy armies of Europe they were 6,000 miles from their base. The men with the spears and swords would engage the European men-at-arms in front and, as soon as they became thoroughly engaged in the combat, the main attack would be launched from behind them by the mounted men with their bows and arrows. This mounted fire action was always decisive and never on any field, no matter what the odds against them, was Genghis Khan ever defeated using these tactics.

I attacked with my air force at St. Mihiel in much the same way. The Germans were confined to a salient; that is, an angle running into our position. I had 1,476 airplanes available for the combat. I so timed the attacks that several hundred would hit from the right side of the salient and then several hundred would hit from the left side. As soon as the combat became general, the main attack was launched by aircraft which had flown clear around both forces and attacked the enemy in the rear. Future wars will see aircraft used in this manner. That is, the air attack will come from whichever direction offers the greatest advantage to the attacker. He has the whole air to operate in and to fly back in. He has the radio to use from ship to ship and he can communicate anywhere he desires. He can use the greatest weapons of all time and can bring about decisions in warfare with a speed never conceived of before. Once the power of initiative is seized by an air force, the opponent had better make peace.

All our old conceptions of navies and military strategy have to be changed, so great has the influence of air power become. It is a distinct move for the betterment of civilization.

END

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The Airlines Prove Themselves

(*Continued from page 26*)

competitive flying was largely eliminated in the interest of safety. Another important step of the same type was the decision of the major airlines to standardize their flying equipment. This resulted in reduction of capital outlay, hastened the solution of many technical problems and furnished flight personnel with a greatly needed breathing spell to catch up with technical progress.

Finally within their own organizations the operators recognized the need for intensive reorganization. In cooperation with the Airline Pilots Association the numerous unsolved points of friction between pilots and executives were brought out into the open and settled by means of arbitration and pilot contracts. Ground personnel was likewise viewed in a new light. Greater responsibility was placed upon operations specialists for flight control. Naturally this necessitated better ground organization as well as more and better trained men. This tendency is borne out by the fact that since 1935 the number of ground personnel in relation to each plane in operation has increased from 16 to 36.

PROGRESS IN FLIGHT TECHNIQUE: Even prior to the disastrous winter of 1936-37 the leading operators had recognized the necessity for more complete pilot training and supervision. This had become apparent soon after the introduction of the high-speed, modern transport. Unfortunately however, few precedents existed and the effort in this direction was not sufficiently intensive to bridge fully the gap between old methods and new demands to forestall trouble. Pilots contrary to popular conception are a conservative breed, not easily changed from existing methods. The airline operators did not fully appreciate this situation. By 1937 events had convinced all concerned that intense pilot training programs had become a necessity.

Improvement of instrument flying technique was the first and foremost objective. Too many accidents had been caused by pilots' lack of confidence in their instrument flying ability and subsequent ill-timed reversals to contact flying. Airline instrument training schools were set up. Use of the Link Trainer and specially equipped instrument training airplanes provided pilots with ample opportunity for practice while off regular flight duty. Ground school training programs were instituted for the development of better navigation. So great has been the progress in these fields that it can be safely said the average airline pilot of today spends fully as much time in training as he does at work.

Increased supervision of pilot personnel was a natural correlation with increased training. In recent years chief pilot duties have become heavy. In addition to exercising executive control over a large group of pilots he must be responsible for the proficiency of them in all the manifold details of the job. Without question this is a key position in the interest of safety.

FLIGHT CONTROL: At one time the responsibility for any flight rested wholly with the pilot flying it. In other words he not only flew the airplane as pilot, but also made the decision as to whether the trip should be flown. He was his own dispatcher and meteorologist. With small scale operations and in the absence of properly qualified ground organization this was a natural condition. The weaknesses of such a system were many as the industry expanded. Pilots were inherently handicapped by the complexities of adverse weather flying and large scale airline operation. At the same time some years of transition have been necessary in order to reach the present day perfection of joint flight control between the individual pilot and the comprehensive viewpoint of ground dispatchers. First efforts in this direction were far from satisfactory due to inexperience on the part of ground personnel. During the past several years however a tremendous improvement has been evident. The government recognized the importance of ground personnel as dispatchers with the adoption of strict licensing standards during 1937. Since then careful regulation, selection and training of such key personnel has indicated the answer to the flight control problem. Admittedly it is a vital and tremendous item in airline safety. No set of regulations can yet be envisioned which even partially approximate the value of experienced and clear-thinking men in such vital posts. The airlines can indeed be considered fortunate in their present appreciation of this.

"We really have the railroads worried—eh, Mac?"

OTHER GROUND PERSONNEL: Less outstanding although fully as important has been the rapid progress made in recent years in raising the standards of all other types of airline personnel. Always efficient the mechanics and numerous affiliated craftsmen necessary for the maintenance of flying equipment have now reached levels of proficiency unequalled in any other branch of transportation. These men too have become highly supervised and strictly regulated by both governmental agencies and their various employers. They too have their training programs. Comprehensive apprentice training programs only recently have been initiated to meet the demands of an expanding industry for capable men. Likewise the development of specialists is encouraged. As a direct consequence standards are high and serious mechanical difficulties are becoming rare in spite of the increased complexity of the modern transport.

REVERSAL OF GOVERNMENTAL POLICIES: Since 1937 the federal government is due as much credit for the furtherance of airline safety as it was blamed prior to that date. Since then backed by public support, political interest and aviation industry insistence, the government has spent millions of dollars toward the improvement of civil aeronautics. All branches of aviation have been beneficiaries.

Probably the outstanding accomplishment was in the long hoped-for release of the industry from the chaotic realm of politics. For years economic progress and proper regulation had been impossible under the threefold dictatorship of the Commerce Department, Post Office Department and Interstate Commerce Commission. With the creation of the Civil Aeronautics Authority the whole industry was given fresh impetus.

Along with this tremendous moral and psychological resurrection of governmental interest in the future of civil aviation, other contributions of material nature have been highly important. Foremost has been the complete modernization and enlargement of the federal airways system. More and improved radio aids to navigation have been vital factors in the virtual elimination of "lost" airplanes. Likewise a much needed expansion of weather reporting facilities

(*Continued on page 67*)

The Birdmen's Perch

Why stay an Amateur Liar? **To all the drawers of long bow among our readers, T.W.T. offers the opportunity to obtain official recognition for your lying ability. Just send us your tallest tale about Gulf Aviation Gas. If we print it, lucky you gets a nifty, specially illustrated Whopper Diploma.**

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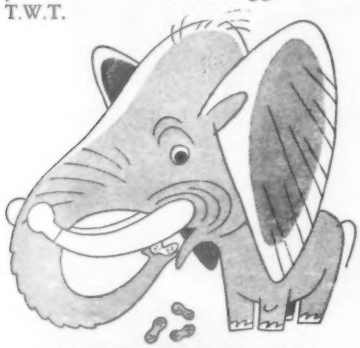
To all—thanks for your whoppers, puzzle solutions, and suggestions—T.W.T.



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CIRCUMNAVIGATORS' SPECIAL

Suppose the earth to be perfectly round and the equator to be a steel ribbon fitting closely around it. If you added 12 inches to the length of the band, how much would the ribbon stand off the surface all the way around?

(This is a problem what is a problem. Send your answer to T.W.T. for checking. But—even if you don't know where to begin—drop a card for the official solution. It'll floor you!)

THIS MONTH'S WHOPPER

Dear Major:

Couple week ago one of them air-plane fellers from the County Seat come high-tailin into the south pasture, sceared our cow Bessie close to death.

Me, I run a fillen station on the side. Kinda calcilated to collect a little folden money from the young fool. He was a slick one though, didn't need no petrol, just wanted to sell Ma and me a ride. Claimed my gas weren't no good, and that he was burnin that Gulf Aviation Gas. Been to the City a few times, and heared tell of the stuff, so I traded my Barred Rock Rooster and the dollar I owed the mail order house for shoes so he'd ride me in the durn thing.

I put on my winter underwear, and Ma dug out the picture box while he started the contraption. Fust off, he let me sit in that cock-pit place so Ma could get my photeegraph. Ain't one to meddle, felt kinda week though so ups and leans on that door knob jigger named Throttle. Plumb nye blew me out of my seat, grabbed for some kinda hand hold, all there was in sight was a sawed-off pitch fork handle sticken up from the floor, got it next time she come by. Spect that made her go up cause my barn moved over, and Bessie scattered the haystack for me. Been busier than one of them City Swing Band Drummers, at a jam session ever since.

How, I come to write you this letter is, that I figgered that cause you make this G.A.G. maybe you can calcilate how much longer I got to stay up here fore this durn flyin machine runs out of gas.

Gettin mighty hungry, and want to get down fore I starve to death. Would have died of thirst if it hadn't rained couple nights back. Please let me know soon as you can, cause I gotta be down in time to help with the harvest this fall, besides, that Airplane feller is getting kinda impatient, He come nye ventillatin me with a twelve gauge yestiday.

IM-Patiently Yours,
(signed) **Bob Renick**

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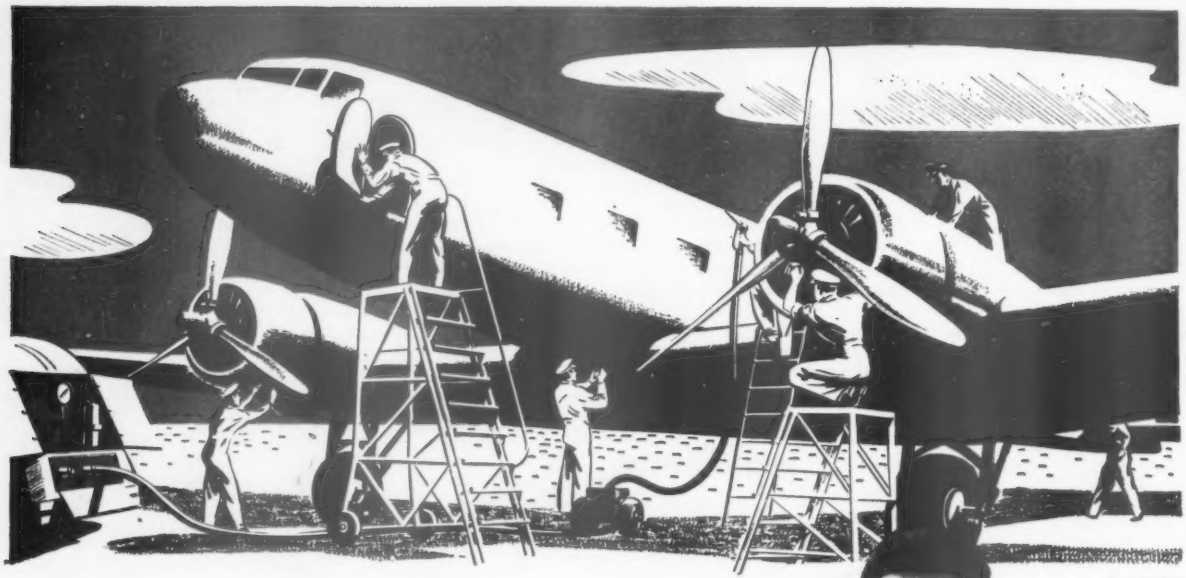

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(*Continued from page* 64)

has bridged many of the troublesome gaps in the weather reporting network. With the introduction of a federally operated airway traffic control system a very necessary safeguard has been provided to meet the potential traffic confusion of rapidly expanding operations. In summary it can be said with some degree of confidence, that government and industry have at last met on the common ground of understanding.

MANUFACTURERS' CONTRIBUTIONS: Less apparent but none the less helpful to the airline safety record has been the effort of the various manufacturers of airline equipment. Improved coordination between airline operators and the manufacturers has resulted in flight equipment designed especially for airline use. Standardization upon a relatively few and proven types of airplanes has brought tremendous economies in investment and operating cost and, as has been noted before, has contributed materially to flight proficiency.

At the same time large sums have been spent in technical research on airplanes, motors and accessories. Much of this was at first a direct loss to the manufacturer, but is now paying dividends in increased airline orders. Flight performance characteristics have been made safer, speed and load carrying ability have increased and general passenger comfort greatly improved.

NEW GADGETS: The layman commonly overvalues the part played by new and radical "cure-all" instruments and accessories. Unfortunate as this may be new gadgets have never yet proved a substitute for the human brain. Many of them do contribute to the lessening of the pilot's work, but on the whole they require that he possess greater intelligence and knowledge in order to make use of them. Nevertheless several items of either new or improved type equipment introduced during the past three years deserve mention.

In the field of navigation the introduction of the shielded loop antenna has been of material benefit. Although not a perfect instrument it has made possible improved radio reception under severe static conditions and in many instances preserved radio reception which would otherwise have been impossible. It also has provided the pilot with a reasonably efficient method of determining his position at any time by means of radio bearings in very much the same manner as has been done for years on marine vessels. Within the last year new and advanced types of automatic direction finders have been placed in service which promise to still further reduce the possibility of navigational error.

The introduction of the so-called full-feathering propeller during 1938 has greatly reduced the hazards of engine failure. The windmill effect of the airflow on an ordinary propeller after engine failure was always troublesome in that it impaired the flying ability of the airplane as well as increased the chances of further damage to the inoperative engine. A full-feathering propeller on the other hand provides a mechanism allowing the pilot to rotate the blades into line with the airflow and thus completely stop the engine if desired. Single engine flight has thus lost much of its hazard.

Although the above two devices may be fairly considered the outstanding technical contributions to be placed in service since 1937 it obviously would be a mistake to forget that many of the most important safety devices are not new developments in the strict sense of the word. Untold improvements have been effected in such accessories as de-icing equipment, automatic pilots, flight instruments and radio equipment. While it is almost impossible to evaluate the importance of any one of these individually in the aggregate they have been tremendous.

In process of development, but not yet in general service, there are numerous other inventions which promise well for the future. Among these are devices for eliminating radio static, an absolute altimeter (furnishing true height above the ground at all times) and various types of blind landing equipment.

WHAT ABOUT TOMORROW? The future of air transportation will be what the airlines make it. It will not be enough to look backward at yesterday's successes. Tomorrow—and it has already started—offers an even greater opportunity for progressive achievements. Not less does it offer a greater challenge and an increased measure of responsibility.

By no means have all the complex problems of airline operation been written off as solved. In any field of endeavor so adolescent and subject to such rapid technical and economic progress an immediate expectation of this would be highly optimistic. Nevertheless like history repeating itself so can major signs marked "danger" be foreseen with the hind sight of past experience.

In any organism rapid growth is usually at the expense of strength. So rapid an expansion as the airlines have enjoyed during the last year (approximately 30 per cent) provides many extra points of weakness that a more conservative progress would have been able to avoid. In particular this great growth has brought with it a tremendous increase of quickly trained personnel. In any other business this might mean only inefficiency and loss of profits, but in this instance it brings potential vulnerability on the score of safety. To be sure more intensive training is being carried on than ever before, but even so the maturing influence of experience is a prerequisite.

After the lean years of the '30s it is natural to make hay while the sun shines. What may not be apparent as yet to the general public is the reoccurrence of the old airline malady of trying to do it at the other fellow's expense. This may be verified by even a casual inspection of the great number of applications for new routes and services which all the airlines have on file in Washington. Although many of these undoubtedly are

(*Continued on page* 86)

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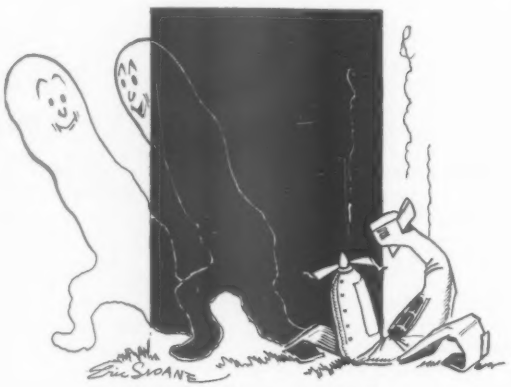
(*Continued from page 21*)

Louisiana and loaded me up with more maps. Waiting for the fog to burn off, I finally took off and made a beeline for Beaumont, Tex. For safety's sake I did something I had read about but never learned first hand. I PXed into Lake Charles, merely by giving the New Orleans tower my altitude, cruising speed, gas stop and probable elapsed time. It was as simple as that and I'll pass the word along to you: by all means use the federal airways facilities and, in doing so, never abuse them. My course lay over swamp, over the bayous and deltas that made the country uniformly rough and wet. It was comforting to be told that only a bare 18 miles, in the center of my course, permitted no landing at all. I PXed with the idea that if a little trouble should develop, searchers would not have to search half of the southwest for me. I would be somewhere beneath that invisible beam that I planned to fly with my portable radio.

Stopping at Lafayette for gas, I soon arrived in Lake Charles and heard the radio calling me and my ship as I circled the field. They included a bit of advice concerning landing since a large crew of men were working on the field. The compass and radio together had made the going very simple, although in the event of trouble it would take a moment or two to pick just that particular spot that looked dry from 3,000 feet. Still, there was *no* place that didn't offer *some* chance of a successful landing. Tex Rankin has explained that without my emphasizing it further.

Entering Texas was an experience. Beaumont was flat and the soil bore trees here and there. As I pushed on to Navasota the sun began to drop down a notch and the late afternoon haze set in. The compass took me most of the way, then the radio was turned on and the east leg of the radio range brought me exactly to the field. In the remaining 10 minutes of daylight the ship was staked down, motor and windshield covered and the bags were hoisted into the car of a woman who had been showing her child the airport at just the right moment. At five in the morning a gas station operator drove me to the field from town and helped fill the ship with five gallons of gas by the light of my flashlight. At 10 in the morning the fog had remained still and the edges of the field were not visible. At two in the afternoon I had spent eight hours in the range station sitting in the little tin house with the operators. Now at last the ceiling was about 900 feet and I left for Waco.

Ten miles out it poured more rain than I've ever seen anywhere. It beat on the little cabin and I went lower, forced down by the wispy clouds that had lowered several hundred feet. No turn could be made, it was necessary to fly straight ahead and watch the railroad and highway through the side window. At 500 feet I raced 40 miles, wanting to land each minute, but the ceiling was so low that maneuvers and turns were impossible. Over each small town I veered slightly to the right, eyes on the tracks, but ready to clear the town in case water should foul the motor. Into a small field I landed like a shot. The field lay next to the railroad and was easily seen. The Lear finally reported Waco clear and unlimited as I sat in the dry cabin in the middle of a downpour. As the skies cleared within the half hour I was soon in Waco and left that field with a thirty mile surface wind. At 2,000 feet I estimated the wind to be 60 m.p.h. and



"Well, kid, they say any landing you can walk away from is good."

held my course in the face of this. Sunset found me only 120 miles beyond Navasota after a full day's flying and waiting to fly. The night was spent in Hamilton, Tex., where the ship had landed in a badly kept emergency field and the wind had brought it to an abrupt halt on the ground, preventing it from rolling into the many rocky mounds on that field.

In the cold morning air we took off with a strong wind that made the run extremely short. With a stop at Brownwood and San Angelo for gas, we began to climb as we saw the mountains rising before us on the horizon. Now the elevations were rising and before us loomed a range that did not appear on the map. This worried us for a short time, but then we remembered that San Angelo had been visible for 30 miles before we reached it. This might be the Guadalupe Pass that lay 65 miles ahead. Sure enough, we now had 6,000 feet and still climbed to leave a safe margin over the Pass. With a stiff tailwind and 10,000 feet of altitude we went sailing through the pass with our eye on the airport that lay ahead on the left. Now and then we glanced down from our great height and watched the tiny cars winding up and down the tortuous roadway that lay through the pass. Contacting the Guadalupe beam we flew along it, taking in the marvelous scenery through spellbound eyes (of course the camera was at the bottom of the luggage pile). When El Paso appeared it was still very far off. We finally pulled in for the night—and for that excursion that must be made at night by every visitor who takes the trolley over the river to Mexico and visits nearby Juarez.

The morning found us at the field bright and early and after the takeoff the Taylorcraft needed no circling but attained a good altitude as we reached the heart of the city and made the turn around the 5,000 foot mountain that lies directly on the course for Lordsburg, N. M. Now we clung to the railroad for endless miles flying at 5,000 feet. The desert country was lonely, trains and cars came along only infrequently.

In Lordsburg we used the telephone on the front of the hangar and were soon gassed by a truck from town. On the railroad again we followed the course recommended to us in El Paso. We bent around mountains, over smaller mountains and at last arrived in Tucson in a high wind. On course for Phoenix, the lonely Desert Peak appeared in the middle of the desert far ahead of the nose of the ship. Visibility was again creating illusions for the eastern flyer who considered 10 miles a good distance to see ahead of him. Encountering sand, we flew above the blowing brown dust and dropped into Phoenix after circling the city and noting its beauty in the desert surrounded by lofty purple mountains.

Here the airport attendant laid out a direct course to Kingman, Ariz., and the 160 miles was over rough mountains every inch of the way. We hopped in again and soon were at 7,500 feet and riding over mountains barren of all signs of life and marked only by great gashes and streams that lay far below the plateaus and peaks. Navigation now was difficult as we were aiming at peaks that seemed to be the peaks on our map, but might not be. With careful regard for the compass we held our breath and wondered if Kingman would appear in the near future. Meeting up with a coal black range of mountains on our left we knew at last we had been on course the whole two hours and soon rounded the bend in a great valley that nestled the airport far below us. Tying down, we felt mighty forlorn in the middle of nowhere. The airport radio man assured us that we were indeed in the middle of nowhere.

Next morning it was cold; it numbed the hands and left a heavy frost on the wings. With the knotted rope we scraped the wings as best we could, paying attention to the ailerons particularly. Now

(*Continued on page 76*)

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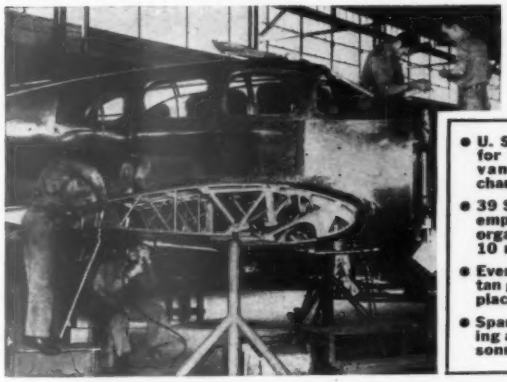

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(5)

Look Out Below!

(*Continued from page 23*)

ant on employing long-range bombers for not-so-long operations — during which time they would necessarily be flying half empty—is the medium-bomber's *raison d'être*. The aircraft plant in question is ringed by anti-aircraft batteries. For this reason the commander decides to commence bombing operations from an altitude of 12,000 feet; but, because errors increase with height, the planes fly no higher than is consistent with safety.

The commander has never seen the objective. How can he tell what sort of a place it is and how did he know that it was built of brick and concrete? That's what Intelligence (G-2) is for. G-2 and reconnaissance fliers have informed him that the plant consists of three factory buildings and a large hangar. These, they said, were arranged fairly close together end-on-end in a linear pattern and they estimate this pattern to be 2,200 feet long and 500 feet wide. From two other probability charts the commander learns that the squadron must drop 25 bombs to be assured only a 90 per cent probability of the required ten hits on a target 2,200 by 500 feet from the selected 12,000-foot level—all of which answers the question "How many more?"

The armorers go to work and the commander and his combat crews pore over a map and work out their route, initial point, axis of attack, method of attack, maneuver after attack and other details.

Shortly the 13-plane unit takes off, each bearing a couple of 1,000-pound demolition bombs. They maintain an extended (loose) formation for control unity until they reach the initial point. Here the fun begins: This is where the planes deploy into three three-ship and one four-ship elements—the patterns required for the attack. Each element has a different axis of attack (which is designated in degrees of the compass) and this enables the bombers to approach the plant from different directions. Such an approach is designed to make the anti-aircraft "ears" and computors cross each other and literally short-circuit the range-finding procedure.

Within range of the enemy aircraft factory, their bombs may be released singly at timed intervals or just dumped. In the former manner the eggs are dropped successively, but in close sequence so that their explosive radii overlap—approximately at half-second intervals from this altitude. When dumped *en masse*, bombs fall "in salvo." This is accomplished on radio signal or as the bombardiers watch the commander's plane and simultaneously release their missiles upon seeing his fall. Formation or pattern bombing is thus accomplished and the design of the exploding eggs is approximately a duplicate of that formation in which the bombers were flying. This, however, is rarely attempted in the face of anti-aircraft opposition which is the reason our squadron has broken up into elements.

As the bombers approach the plant, let us consider the mechanics involved in the dropping of the eggs. Do the bombs fall straight down? Does the plane's speed affect their plunge; or the wind? Once released from the racks which suspend them in the ship's bomb "bay" or "loft," the missiles react queerly to their sudden freedom, whooshing along with the bomber as if reluctant to part with it. Throughout the remainder of their hell-bent journey they describe a long curve or parabola. Ballistics concern bombs even as they do bullets or shells. The bomb is imparted forward movement in much the same manner as is the bullet; it is not forcibly ejected but is given forward movement by the plane's speed. Travel from the point of release to where the missile hits is called "range" and this varies according to ground speed, altitude and the air's resistance.

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However, the air's resistance brings into effect two factors known as "ground lag" and "time lag." If the bomb trajectory were computed on the assumption that the missile falls through a vacuum, neither of these lags would have to be considered, but air slows up both the bomb's forward travel and its falling speed, although to a very slight degree. Ground lag is the result of the former effect; it is the distance by which the bomb path lags behind the perfect or vacuum path. If not compensated for, this would make the bomb hit short of the target by about 200 feet. Time lag is the result of the slowing of the missile's falling speed due to air resistance: It would fall in a vacuum path 12,000 feet in a fraction less than 27.5 seconds, but the air will actually slow it up so that the bomb will take 30 some seconds to reach earth. Considering that a 240-mile plane is traveling 352.8 feet per second, the lag must be accounted for.

"But how can a guy figure all this when he's got to drop his bombs and get away?" you ask. There's much more to be considered; wind, for example. That is why no mention has been made of airspeed thus far, although airspeed must be accounted for in figuring the bomb's lag. Head or tail winds detract from and add to ground speed, but the apparent movement of the ground is coincident with the plane's heading. In a cross-wind the apparent ground movement may be at an angle to the bomber's heading in which case "drift angle" and "deflection offset" must be given immediate consideration. Because of all this the bomb, upon release, is imparted a *sidewise* movement as well as a forward movement.

Nor is this quite all. There are a lot of "indeterminate errors" that have to do with defective bombs and instruments, human element and very slight deviations caused by changes of wind at different altitudes through which the bomb falls. But all these frowns and formulae are simplified to an amazing degree by the bombing sight. Our squadron is now almost to the enemy factory and the bombing team—pilot and bombardier—of each plane is getting set. The bombardier, from information supplied by the pilot or navigator, makes settings and adjustments on his sight to correspond with the ship's air and ground speed, altitude, drift, type and terminal velocity of the two bombs and his "line of sight." (The latter can be made by observing any conspicuous object on the ground during the flight.) . Then he sets a shutter to compensate for the two-fifths second personal time lag in using the release.

The bombardier sights down and ahead along the line of sight through the telescopic view-finder (see drawing). The factory buildings slide under the cross-hairs in his sight and he presses a button. But he keeps watch through the view-finder along the "tail sight" line to see where the bomb hits. If it hap-

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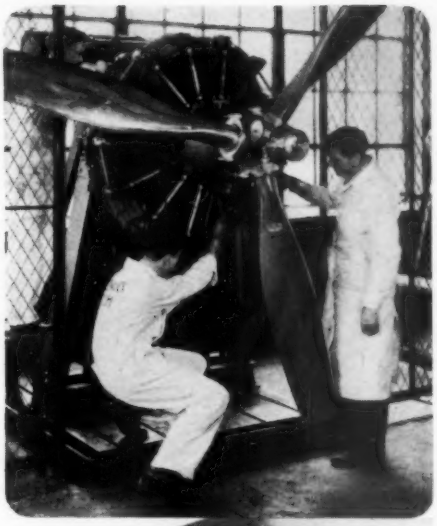

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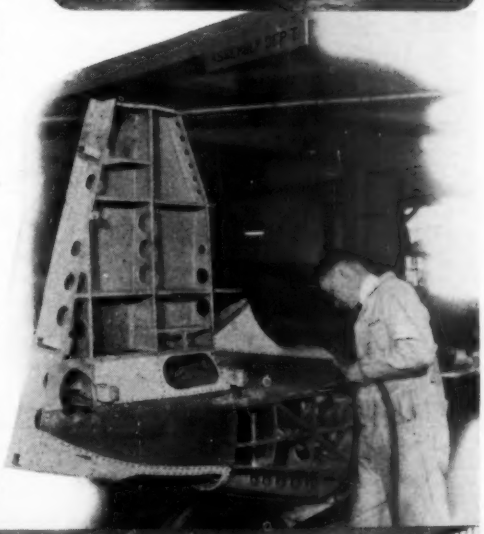

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(*Continued from page 23*)

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The commander has never seen the objective. How can he tell what sort of a place it is and how did he know that it was built of brick and concrete? That's what Intelligence (G-2) is for. G-2 and reconnaissance fliers have informed him that the plant consists of three factory buildings and a large hangar. These, they said, were arranged fairly close together end-on-end in a linear pattern and they estimate this pattern to be 2,200 feet long and 500 feet wide. From two other probability charts the commander learns that the squadron must drop 25 bombs to be assured only a 90 per cent probability of the required ten hits on a target 2,200 by 500 feet from the selected 12,000-foot level—all of which answers the question "How many more?"

The armorers go to work and the commander and his combat crews pore over a map and work out their route, initial point, axis of attack, method of attack, maneuver after attack and other details.

Shortly the 13-plane unit takes off, each bearing a couple of 1,000-pound demolition bombs. They maintain an extended (loose) formation for control unity until they reach the initial point. Here the fun begins: This is where the planes deploy into three three-ship and one four-ship elements—the patterns required for the attack. Each element has a different axis of attack (which is designated in degrees of the compass) and this enables the bombers to approach the plant from different directions. Such an approach is designed to make the anti-aircraft "ears" and computors cross each other and literally short-circuit the range-finding procedure.

Within range of the enemy aircraft factory, their bombs may be released singly at timed intervals or just dumped. In the former manner the eggs are dropped successively, but in close sequence so that their explosive radii overlap—approximately at half-second intervals from this altitude. When dumped *en masse,* bombs fall "in salvo." This is accomplished on radio signal or as the bombardiers watch the commander's plane and simultaneously release their missiles upon seeing his fall. Formation or pattern bombing is thus accomplished and the design of the exploding eggs is approximately a duplicate of that formation in which the bombers were flying. This, however, is rarely attempted in the face of anti-aircraft opposition which is the reason our squadron has broken up into elements.

As the bombers approach the plant, let us consider the mechanics involved in the dropping of the eggs. Do the bombs fall straight down? Does the plane's speed affect their plunge; or the wind? Once released from the racks which suspend them in the ship's bomb "bay" or "loft," the missiles react queerly to their sudden freedom, whooshing along with the bomber as if reluctant to part with it. Throughout the remainder of their hell-bent journey they describe a long curve or parabola. Ballistics concern bombs even as they do bullets or shells. The bomb is imparted forward movement in much the same manner as is the bullet; it is not forcibly ejected but is given forward movement by the plane's speed. Travel from the point of release to where the missile hits is called "range" and this varies according to ground speed, altitude and the air's resistance.

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Our bombers are cruising at 240 m.p.h. and from 12,000 feet the bomb will have a range of 9,780 feet—more than a mile and three-quarters from the release point. At the same speed from 6,000 feet the range would be 7,824 feet—which demonstrates how altitude affects accuracy. And from the same 6,000-foot level at only 120 m.p.h. the bomb would travel only 3,412 feet forward—which shows what speed has to do with it all.

However, the air's resistance brings into effect two factors known as "ground lag" and "time lag." If the bomb trajectory were computed on the assumption that the missile falls through a vacuum, neither of these lags would have to be considered, but air slows up both the bomb's forward travel and its falling speed, although to a very slight degree. Ground lag is the result of the former effect; it is the distance by which the bomb path lags behind the perfect or vacuum path. If not compensated for, this would make the bomb hit short of the target by about 200 feet. Time lag is the result of the slowing of the missile's falling speed due to air resistance: It would fall in a vacuum path 12,000 feet in a fraction less than 27.5 seconds, but the air will actually slow it up so that the bomb will take 30 some seconds to reach earth. Considering that a 240-mile plane is traveling 352.8 feet per second, the lag must be accounted for.

"But how can a guy figure all this when he's got to drop his bombs and get away?" you ask. There's much more to be considered; wind, for example. That is why no mention has been made of airspeed thus far, although airspeed must be accounted for in figuring the bomb's lag. Head or tail winds detract from and add to ground speed, but the apparent movement of the ground is coincident with the plane's heading. In a cross-wind the apparent ground movement may be at an angle to the bomber's heading in which case "drift angle" and "deflection offset" must be given immediate consideration. Because of all this the bomb, upon release, is imparted a *sidewise* movement as well as a forward movement.

Nor is this quite all. There are a lot of "indeterminate errors" that have to do with defective bombs and instruments, human element and very slight deviations caused by changes of wind at different altitudes through which the bomb falls. But all these frowns and formulae are simplified to an amazing degree by the bombing sight. Our squadron is now almost to the enemy factory and the bombing team—pilot and bombardier—of each plane is getting set. The bombardier, from information supplied by the pilot or navigator, makes settings and adjustments on his sight to correspond with the ship's air and ground speed, altitude, drift, type and terminal velocity of the two bombs and his "line of sight." (The latter can be made by observing any conspicuous object on the ground during the flight.) . Then he sets a shutter to compensate for the two-fifths second personal time lag in using the release.

The bombardier sights down and ahead along the line of sight through the telescopic view-finder (see drawing). The factory buildings slide under the cross-hairs in his sight and he presses a button. But he keeps watch through the view-finder along the "tail sight" line to see where the bomb hits. If it hap-

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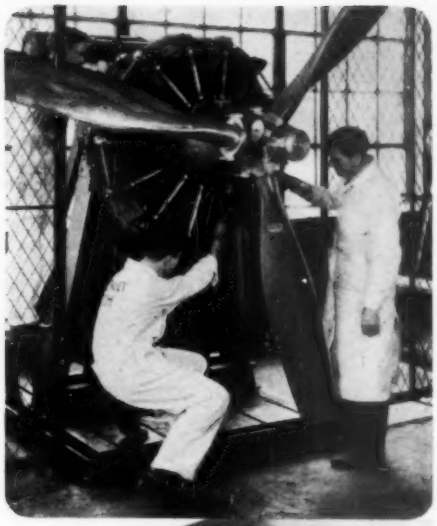

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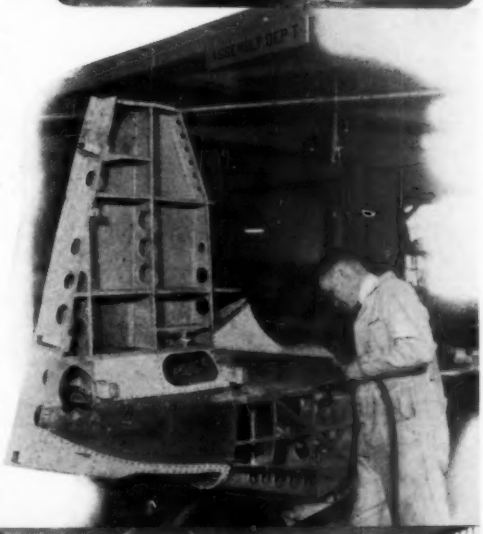

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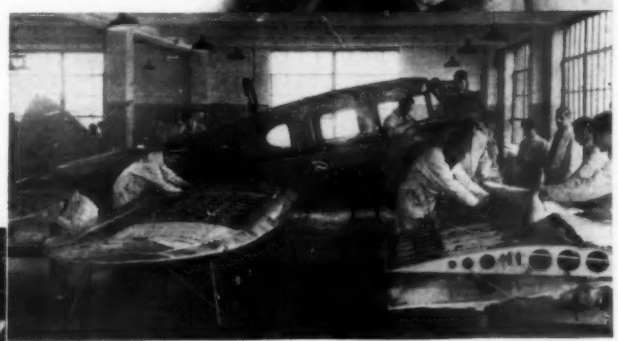

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pens to be short or over or to either side, he makes another adjustment on a correction scale—the next time over, it's a dead ringer!

But if this were the super-secret Sperry bombing sight, there would be no "next time over." Now several years old, this marvel mechanism was originally developed for the Navy to replace their old Wimperis Mk. III sight. Both the Army and Navy now use the Sperry device. The incidents of dropping a bomb in a barrel from above 20,000 feet and hitting a small square target from 30,000 are pretty well known. Not so well known, however (and we're not revealing any secrets!) is the fact that the miracle sight affords equal accuracy even though the bomber is flying in a shallow turn. This is not to facilitate "trick shots," but is distinctly a safety measure. Heretofore bombers had to fly a perfectly straight, constant course through the bombardier's sighting operation. During this interval they were cold meat for the anti-aircraft gunners. Now it's a different story and the anti-aircraft gunners will have a tough time out-guessing acrobatic bombers. A complex bird, the modern bombing plane; and the eggs she hatches upon the military and helpless alike make her more to be feared than any of man's weapons.

Bombs come in assorted shapes and sizes. There are five-pounders about the length of a cop's mace and the same shape; and there are 18-foot, 4,000-pound super bombs. "Fragmentation" types burst into hundreds of pieces of shrapnel and are used for the most part against troops in the field, anti-aircraft emplacements and air bases. "Demolition" bombs, the behavior of which are self-evident, are dropped upon more substantial targets such as that aircraft factory, fortifications and ships. The "chemical" variety comprises gas, incendiary (like the 4,000° thermite bombs) and toxic; these are perhaps the most evil of all.

The liquid-air bomb, a demolition type, is said to be the most destructive. Number one bomber boy, Lester P. Barlow of Martin Aircraft, is now conducting tests before service officials with a reputedly improved type incorporating a chemical formula known as LOX or RPX which contains a combination of liquid-oxygen, softwood carbon and ammonium phosphate.

A bomb's terrific concussion or outward-pushing force of explosion is only half its destructive power. A tremendous vacuum immediately follows detonation which experts believe exceeds the initial force. When the air rushes into this space the walls of nearby buildings are drawn *outward*, not pushed in—which is why the streets are always filled with debris after an air raid.

But America's streets should never be cluttered with bomb wreckage so long as we have Barlow bombs, Sperry sights to aim them and almost 400-mile per hour Douglas and Consolidated bombers to carry them because retaliation in kind—or the threat of it—is the best known form of air insurance.

END

Aircraft Hydraulics

(*Continued from page* 44)

the piston is extended, the volume of such a cylinder would be 17.8 cubic inches. To completely extend our cylinder from the compressed condition would require 17.8 movements of the pump. The force delivered by the operating cylinder would be 1,490 pounds, which is the product of piston area times pressure.

To fully appreciate the vast mechanical advantage that can be obtained, let's assume our operating cylinder to have a bore of three inches (area: 7.06 square inches). With the same length of 18 inches, the volume goes up to 125 cubic inches. This would require 125 motions of 62½ completed cycles of operation of the hand pump to extend the cylinder while the force of the cylinder has increased to 10,590 pounds, the product of area times pressure.

Again considering the cylinder to have a bore of three inches, should we use a piston rod of 1½ inches the area would be reduced by 1 76 square inch with an area of 5.3 square inches for the motion of retracting the piston into the cylinder. It would require 95.4 cubic inches of fluid to displace the piston and be capable of delivering force of 7,950 pounds.

The high degree of versatility as is afforded by the hydraulic system should be very apparent from the foregoing, insofar as the selection of operating cylinder requirements are concerned. In one instance it might be desirable or necessary to provide considerably more effort in one direction than the other while on the other hand it is possible to maintain very close to the same available force in either direction. Should the same force be a definite requirement it can be achieved by extending piston rods from both ends of the cylinder. It also follows that the matter of "motion limit control" can easily be obtained by limiting piston motion. The matter of limiting motion is one of the worst bugaboos encountered in electrical or mechanical motion systems.

The efficiency of hydraulic systems will vary from 75 to 95 per cent, depending on types of packing used and sizes of lines and other factors. Relatively high efficiencies can be retained in manually operated systems and usually, as engine-driven pumps are added, the degree of efficiency is not critical.

The ease of installation of the tubing and lines that are necessary to connect the various units only adds to the many reasons for the employment of hydraulic systems. Virtually all tubing fittings used are of the multiple piece type, since they are superior to the one piece type when used in cramped places or will require routine removal and replacement.

Fluids employed in hydraulic systems have been the worst fault that has entered into the picture. The use of "Lockheed fluid" was continued for a long time. But, while it permitted the use of packing materials of relatively low friction values, it also developed several serious faults. The thermal coefficient of the fluid indicates its instability, its volume changing approximately one per cent for each 15° F. of temperature change. Further, the fluid is not too stable chemically. This is particularly true when water is introduced and hydrolizing occurs. At elevated temperatures no lubrication is provided. Even with the use of the best fluids, early deterioration destroys the packing materials and the use of substitutes has given unsatisfactory results. This situation is one that led the aviation industry to enter the field of mineral oils for fluids. Today packing materials of satisfactory characteristics are being produced for use with mineral base oils.

The matter of weight saving is one that is questionable in systems operating only one device. That is to say that, if an airplane had only a retractable landing gear, a hydraulic system might or might not be more economical in weight. Definitely, when more than one device is to be operated hydraulic systems can be used to the advantage of weight saving.

END

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He Prefers Slots

(*Continued from page 35*)

learn to fly and I was one of them," he says. "Among the 'membership' were Bill Daniels, a cameraman; Merrill Pye, an art director; Tay Garnett, who had flown during the war and is a well-known director today; Buddy Gillespie, art director who later married Ruth Elder; Wesley Miller, associated with me in the sound department; Jimmy Manett and Ray Binger, both cameramen.

"Our instructors were Harry Ashe, an ex-Army pilot who later became pilot for William Gibbs McAdoo and Francis Durfee. We flew in Monocoupes with 55 h.p. engines. We used the Culver City airport. We all soloed in about 10 hours. I got my private license and have held it ever since. In 1930 I bought the Avro because I liked the Handley-Page wing slots.

"I believe I am the only one of the original group of about 16 who still is flying. The main reason seems to be that the other members never found the type of plane they wanted."

To say that Shearer likes his Avro is putting it mildly. Now that slots are finally being adopted in this country—Lockheed, Douglas, Stinson and a number of other manufacturers are using the fixed type on certain models—his comments are interesting.

"My experience with my ship," he says, "has been that I have two types of landing available. The first is the conventional glide landing. The second is the stall landing with slots in full operation. Many times, in forced landings, I've had occasion to rely on them when faced with tight emergency fields.

"The most interesting experiment I ever conducted was descending for 2,000 feet beside an autogiro at its slowest power-off speed. The ship is safe at double the angle of attack of most ships not equipped with slots. I get in and out of my tight 450-foot landing field at my ranch without difficulty. And I recall once, when I was looking for San Jose under an overcast, I sat down in a farmer's back yard, taxied to his doorstep and inquired the way to the field. It turned out to be just beyond a nearby row of trees. Had I not had the type of ship I fly, I'd probably have flown back 50 miles before being able to sit down safely, with consequent loss of time and a long drive to complete the trip."

Shearer has a picture of which he is very proud. He tried to get into the boxed 550-foot field one day, not knowing that the field had been ploughed and rain had soaked it. The ship hit the muck, rolled a few feet, went up on its nose, bent only the propeller and then settled to a three-point landing of two wheels and one prop.

"From the point of contact to the point of final rest was a distance of only 18 feet," he says. "Show me the conventional plane that'll land like that without really cracking up."

His only other mishap occurred near the town of Birney, Mont. He was coming around the base of one of the Big Horn mountains for a landing. Rugged terrain resulted in a change from a five-mile headwind to a tailwind. The ship "dropped out" and washed out half the undercarriage. However, the slots kept the ship in a three-point position before it hit, resulting in minimum damage.

Shearer went from the *Cirrus* to the Menasco in 1931 because he was having trouble getting replacement parts. Here entered his inquiring mind. He designed his own cowling and air cooling system and the motor has functioned perfectly ever since under all conditions. He developed, in this connection, a venturi exhaust system.

When radio became widely used Shearer, being a sound man, was very much interested. He installed a receiving set and immediately began having trouble with the conventional trailing antenna. So he thought the problem over and designed an airplane with a wingspread of about five inches, made of brass. He allowed this to fly upside down at the end of his trailing wire with the flipper so adjusted that it was continually trying to dive. Lighter than the average "sinker" it still pulled downward harder on his antenna. It banked nicely on the turns, too. The flippers were adjustable simply by bending. He still uses it.

"I'm in favor of radio. Being a commuter I have radio in my office and at my ranch, with a weather broadcasting band. I always know whether I can take-off in either direction and make it. And, when I'm in the air, I can get last minute reports."

Normally, Shearer makes the 96 miles to his ranch in about 55 minutes. On occasion he hasn't liked the looks of the weather ahead—this occurred before he started getting radio reports—he has set the ship down in some small field and has walked to the nearest highway.

"Fifteen miles, yes," he says. "But safe miles."

Another installation was a Townend ring over his windshields to cut out burble in the cockpits. Not only are the cockpits more comfortable for Shearer and his wife (his constant flight companion unless his mother is taking a hop) but resistance is cut down.

When David Davis, a one-time Douglas engineer, was conducting airfoil experiments which finally resulted in the famous "mystery airfoil" (see POPULAR AVIATION, June, 1940), Shearer was his aide. On top of Shearer's fast roadster they constructed an apparatus which held test airfoils. Holes in the airfoils permitted air pressure to drive liquid in manometer tubes behind the driving compartment. The height of the liquid in the many tubes, arranged like teeth in a comb, showed the amount of pressure exerted on each section of the airfoil. The pressure effect was "photographed" on blueprint paper. The result was an accurate pressure report curve, which allowed for changes in the airfoils to improve their efficiency.

Shearer, now 40, expects to continue to fly for some years to come—in fact, indefinitely.

"I started flying for the sport and the

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thrill of it," he says. "However, planes these days offer more than sport—fast, efficient and economical transportation and can be perfectly safe as well—if the designer doesn't forget that all birds have a slow landing speed and a wing design that won't spin."

One of Shearer's hobbies is aerial photography. Coupled with this is his study of ornithology. His principal interest in birds is in their wings and he points to the fact that they fly with slots. His photographs show birds landing, taking off and in flight and his study of wing structure clearly shows the employment of certain feathers on leading edges as slots in landing.

"The owl, for instance," he points out, "has one particularly tough feather which is operated by a muscle and is on the leading edge of both his wings. Photographs show him using this."

Shearer believes, as do advanced manufacturers, that slots will be used from here on out, spreading through the industry.

"A man would not want to drive a car," he says, "if, when he slowed to 25 m.p.h., the steering gear automatically became inoperative. The same thing goes for an airplane."

Shearer conducted his experiments in descent beside autogiros both in New York City and Palm Springs. He has figures to show a descent of approximately 15 feet per second, at a forward speed of not much more. Again and again, he has attempted spins with no success. One of his stories concerns a Navy pilot who had been flying a slotted wing job for four years and always had glided it in for a landing.

"Pull the stick back to your stomach and let her come in," Shearer told him.

"It's impossible without spinning," said the officer, "but I'll get high and try it." He did. He was supposed to continue in the air at the time, flying back to his base. But he came in for a landing to elatedly report his newly found maneuver.

"And to think," he said, "that I've been flying this crate for four years, thinking all the time it would spin if stalled!"

Shearer flew his small ship to New York from Los Angeles in 1932.

"I'd like to do it again," he says. "Flight accommodations have improved in every way. I recall that on my trip to New York City there were few intermediate fields, no beacon lights, no radio beams. Places to eat and places to stay were too far apart. I enjoyed the trip, but I felt like a pioneer and was plenty tired."

Oddly enough, Shearer's greatest thrill has not come from flying an airplane, but from going aloft in a captive balloon in 1926 to photograph a parachute jumper straight down, with the ground as background.

"We had no basket on the balloon and a plank had been set in the rigging for us. As the balloon's cable was let out, the plank slipped. We yelled, but we were too high for the man on the winch to hear us. So we went up to 2,500 feet, clinging to the teetering plank, turning cameras, and wondering when our unparachuted bodies would go plummeting downward. But we managed to get the shots and were pulled back in safely.

"However, in all my years of flying, there has been no hair-raising, breath-taking, spine-chilling experience like that. In fact, you can have your balloons. I'll take slots."

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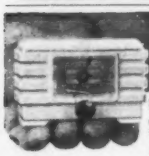

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Across the U. S.

(*Continued from page 68*)

we PXed once more to Daggett, Cal., and gained 8,500 feet for the hop over the Mojave Desert to avoid the downdrafts that we knew to lie in the pointed peaks and valleys beneath us. At Daggett we bought some U.S.A. emergency gallons (sold in lots of five gallons only) and left behind us a DC-2 with a crippled engine and its crew of Army flyers. We had PXed for the next leg into Bakersfield, Cal., and were now over the Tehacapi Pass at 9,000 feet. We could see the double railroad tracks round the curve of the mountain as they crossed the plateau through Tehacapi. Now the railroad and we too were going to descend into the San Joaquin Valley and Bakersfield.

Faintly the call came: "Ewing—Taylorcraft—NC-22265." We were being advised that Bakersfield had a 350 foot ceiling. Since we had noted all airports passed over, we had marked well the Tehacapi field and now dropped down to land at an elevation of 3,500 feet. We called the Bakersfield radio control and informed them of our location. In the morning we were able to drop down the side of the mountains and land on a sheep ranch on the mountainside. Spending most of the forenoon here we finally found the ceiling lifting and the fog disappearing. Into Bakersfield we flew, down the side of the mountain and above the railroad tracks. At last we were on the valley floor at 700 feet altitude. Since we had phoned ahead and were warned of the military maneuvers in progress we headed for a level piece of ground and landed. Phoning again we received permission to fly into the airport during the next 15 minutes. Once there, we were forced to remain.

Starting out, next morning, the weather was barely contact. We flew contact over the railroad into Modesto, then over the low hills on course to Oakland were flown by keeping one eye on the ground, both ears on the beam.

I had learned much. A lightplane should indeed carry an inexpensive radio. Maps must be purchased *before* starting a trip; you'll not find them available enroute. Navigation was merely a question of sitting and waiting for the expected landmarks to appear; they always do if you'll just hold that compass heading and watch your drift. At no time did the lightplane have difficulty landing and taking off with full load at high altitudes. Finally I reached one great conclusion: the air everywhere welcomes the amateur pilot who will watch his weather and gas supply, give heed to proper equipment and will, above all, use his head at all times. I'll guarantee that you'll discover on a trip such as this that your lightplane is every inch a sturdy airplane that will get you there safely and comfortably. My cost from Miami was $27.50 for gas and oil. My complete trip measured 5,600 miles, it was flown in 75 hours (December 26-January 19) and the average speed was close to 85 m.p.h. In one long day, leaving early in the morning and arriving in mid-afternoon, I had covered 575 miles. At extremely high altitudes the motor can be revved up safely and in one day's flying I averaged 92 m.p.h. by a standard flight calculator.

I had many hosts and hostesses across the country; they appeared like magic when I landed for the night. In each case they took me in for the night and I know I'll find that they've been flying when I see them again. They, too, will become loyal flyers—and will be picking their way along these great air highways with me soon, I hope.

END

Extra Instruments

ROSCOE TURNER has ordered a Stinson "105" which, in addition to the usual engine instruments will be fitted with a directional gyro and clock taken from his Wedell racer, Kollsman sensitive altimeter, bank and turn indicator, rate of climb and Kollsman directional indicator. It will be bonded and shielded for two-way radio. Another "105", ordered by Howard Hughes, will be equipped with an electric starter, steerable tail wheel, extra gas tank and provision for blind flying instruments.

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P. A. AUGUST, 1940

Zero Zero—But Safe

(*Continued from page* 14)

Dozens of workable systems have been invented during the last decade and many of them were tested successfully. The problem before the government today is no longer whether airplanes can be landed blind; the problem is what is the best way to do it.

There is no unanimity of technical opinion of just what is the best way. Meanwhile instrument landing has progressed far beyond the stage where difference of technical opinion could be settled on paper. The time has now come for actual comparisons in the field under flying conditions.

To provide the equipment for such tests whereby a great number of pilots could be trained how to land blind, and to observe at first hand the advantages and the inevitable shortcomings of what is now, theoretically at least, the best system today. The Civil Aeronautics Authority has invited bids from private manufacturers for the construction and installation of the latest C. A. A. systems at 10 of the country's largest airports. In addition the bids provide for the delivery of one mobile system mounted on trucks to be used in selecting sites for permanent installation of the fixed systems. The job will be completed with ample time for flight testing, before the winter of 1941.

These 10 new installations (their number may be raised to 15) are intended principally for pilot training and for fact-finding. As the pilots become more familiar with instrument landing procedure and more confident of their ability to land blind under actual conditions of low ceiling and visibility, C. A. A. will gradually lower its weather minimum until totally blind landings are finally authorized as a routine procedure.

C. A. A.'s present installation at Indianapolis is conceded to be the best system in the world today. Despite this fact it is far from perfection. The 10 systems to be built by the C. A. A. in its 1940-41 program will be much improved; however, they too will not be perfect. Absolute perfection, of course, will never be reached, but we are coming close to it.

The perfect system should be able to serve equally well a large lumbering airliner making a steady smooth approach and a fast, nimble pursuit coming in steeply for a landing. It should be able to guide an amphibian airplane to a safe landing on water as well as on land. It should be so constituted that it could be built in mobile as well as in fixed units to permit bad weather operation of military aircraft at improvised fields. It now appears certain that only a three-element system could do such a job, that is, one having a localizer, a glide path and one or two markers.

Construction of a suitable localizer to meet these variable conditions presents no difficulties. It could be either of the four-course or two-course type whichever the pilots may eventually prefer. Its beam could be extended to 30 or 40 miles away from the airport to provide guidance for initial approach as well as the actual landing. It could easily be made in fixed or mobile form for land or sea use and its antennas could be placed sufficiently far from the point of landing contact so as not to constitute an obstruction to the landing aircraft.

Similarly the marker beacons are equally modest in their installation requirements and could be easily adapted for service under variable conditions.

The most difficult element is that of the glide path. Ideally, the transmitter should eliminate in space a straight-line glide path from a point about 15 miles distant from the airport down to within about 50 feet above the ground near the edge of the airport where the glide path should gently shallow out to permit smooth normal contact of the airplane with the landing terrain. A glide path of this type has been attempted in the C. A. A.'s Indianapolis installation and present indications are that radio engineers should be able to solve this problem in the forthcoming 10 installations.

In the Indianapolis installation the glide path is obtained by projecting an irregularly shaped radiation pattern at an angle with the runway by means of a multiple antenna array. The radiation is so adjusted that the line of constant field intensity which the airplane follows in making the landing approach is straight *along the localizer course* and curves gently at the bottom to the point of contact with the runway. Actually in the Indianapolis installation this glide path does not form a perfectly straight line; further adjustments of the transmitting antenna array are needed to produce the ideal glide path.

This newly-developed glide path appears to be ideal for fixed installations to serve landplanes. It can be used by aircraft having different gliding characteristics and the glide path transmitter antennas, being located off the runway, do not constitute an obstruction in the path of the landing aircraft. However the system is not well adapted for mobile use as the antenna array must be adjusted accurately and tested on location for a long period before the desired glide path is obtained.

The older curved-line glide path, though less satisfactory, is much easier to obtain in a mobile installation. It is difficult to extend this type of glide path more than three or four miles beyond the airport and in its final approach it levels off to a very small angle at a considerable distance from the transmitter. The transmitter unit must be located on the runway or close to it and may constitute an obstruction.

Perfection of a universal glide path, one which could be built for either fixed or mobile installations, to serve both landplanes and seaplanes, now constitutes the principal problem which it is hoped will be solved in 1940.

The glide paths now available though not ideal are entirely serviceable. More than 2,000 safe landings have been made to date on the various systems built in the United States without a single accident; most of the landings were made "under the hood", but a great many were made under actual conditions of low visibility. The question is primarily that of standardization.

Standardization can best be achieved by giving first hand experience in instrument landing to the greatest possible number of pilots flying various types of aircrtft. The experience thus gained by the pilots not only will help to crystallize engineering opinion as to necessary further improvements, but also will stand these pilots in good stead when instrument landing becomes a routine procedure on our airways.

That day is close at hand. With the forthcoming installations instrument approach procedure using the new blind landing aids will be made in routine operations regardless of weather conditions. As the pilots become more confident of their ability to land blind and become more familiar with the capabilities and limitations of the equipment, the operating ceiling minima will be

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Col. Knox's announcement followed the statement in Washington by Chairman Robert H. Hinckley, of the Civilian Aeronautics Authority, that primary flight training would be given to 45,000 new pilots by July 1, 1941. These pilots will receive from thirty-five to fifty hours of training and the top 9,000 of them will then receive an additional secondary training course of forty-five to fifty hours. The training and standardization of 9,000 instructors is also included in the program.

Applications Pouring In

Applications for the training course are pouring into the C. A. A. headquarters by the thousands and a problem of selection of the first 15,000 students already confronts those in charge, according to Col. Knox. There are more applicants for ... camps than can be han... summer ... that the a...

—From the N. Y. Herald-Tribune

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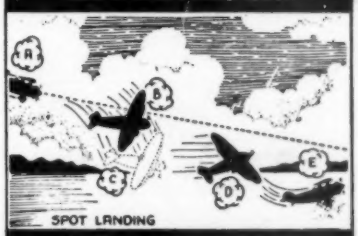

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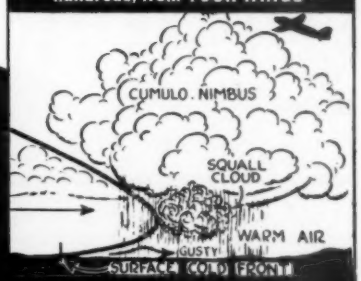

Sample meteorological drawing (much reduced) showing safe flying level, from THROUGH THE OVERCAST

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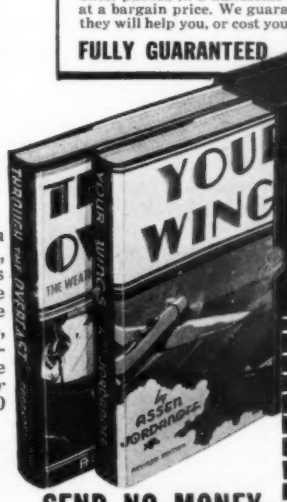

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gradually reduced by the C. A. A., permitting airline operations in conditions now considered unflyable.

The 10 fixed systems will not fill the need for nationwide instrument landing facilities, but will only provide aid on a few through airline runs between key cities. Between 40 and 60 installations would be needed for normal commercial operations—79 airports are now equipped for radio traffic control. Their number is growing and eventually all will require instrument landing aids.

In addition to our commercial landplane operations similar systems will be needed for our commercial seaplane services, especially those in transoceanic air commerce. Army, Navy and Coast Guard will require many more installations for the efficient functioning of their planes in peace or war.

The vast network of instrument landing aids which we can now envision will revolutionize our concept of air transportation. It is then that flying will become wholly independent of weather and will take its rightful place among the major transportation methods of the world. Possession of such a network, nationwide in scope and reliable in performance, will be an economic and military asset of untold importance.

That's why, in 1940, the eyes of the industry are directed to the important decisions about to be made on the future progress of instrument landing.

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Navigation

(*Continued from page* 44)

to the north of the Rhumb line track in north latitude. A new, and what is believed a more practicable method is shown graphically in Fig. 1.

The same formula is used with part of the problem solved graphically. The compass rose shown is part of the Universal Plotting Sheet, which many navigators will have at hand as part of their navigation notebook.

To illustrate this method, we will give one example:

EXAMPLE (See page 127, British edition of Air Navigation): Find the angle necessary to convert the Mercator course to the initial great circle course, when flying from Lat. 38°-03′N., Long. 5°-00′W. to Lat. 44°-19′N., Long. 18°-11′W.

Solution: L_1 38°-13′N Long$_1$ 5°-00′W
L_2 44°-19′N Long$_2$ 18°-11′W

L_m 41°-11′N. Diff L. 13°-L1′W

In Fig. 1 mark mid-latitude (41°-11′) on rose as shown, and draw horizontal line through mid-latitude cutting vertical scale. The point intercepted on the vertical scale is the sine of the mid-latitude, or 39′ .7.

Therefore, the conversion angle is

$$\frac{39'.7}{60} \times \frac{13.2}{2} = 4^\circ .4.$$

The Mercator course is 302° .4, therefore the great circle course is 306° .8.

APPLYING THE CONVERSION ANGLE

Since the great circle track, except when it coincides with a meridian or the equator, passes into higher latitudes than the Mercator track, it is only necessary to keep this fact in mind when making conversions. For example, in north latitude on a westerly course the conversion angle would be added to a Mercator course or subtracted from a great circle course.

PRACTICAL USE OF THE CONVERSION ANGLE

In practice it is not possible to keep continuously on the great circle track. In fact, it might become necessary to make radical changes in course due to storm areas on to other causes, and under such conditions new great circle courses will be required from time to time.

A simple method whereby these course conversions may be done simply and quickly is therefore most desirable, and the simple formula, Con. Angle $= \frac{DLo}{2}$ sine L_m seems to meet the need when worked graphically. The great circle distance is also needed by the air navigator.

The great circle distance may of course be computed at leisure before the takeoff, but once in the air and committed to the flight, the important factor is the course.

The speed is affected by winds and other factors, but eventually, if the *correct course* is followed, the plane will pass over the destination, and since the ground speed may be controlled within wide limits by means of the engine throttle, the desired schedule may usually be followed. On the other hand, if off the course the plane might miss its objective entirely, hence the importance of maintaining the proper course.

SMALL SCALE MERCATOR CONTROL CHART

While it is difficult to measure an accurate distance on a small scale Mercator chart, courses may be laid off and measured to within two to three-tenths of a degree, which is amply accurate for practical navigation.

Therefore, if a navigator has available a Mercator chart on a scale about one to five million (now available), he may measure the Rhumb line course and convert this to a great circle course very easily as outlined above.

This may be done either at points along the great circle track or at any point at which a ship or plane might be located. The method is therefore universal in application and simple to use. A little practice with the formula and the method for applying the conversion angle makes the method extremely easy.

CONVERSION ANGLE FOR CONVERTING GREAT CIRCLE COURSES TO RHUMB LINE COURSES AND VICE VERSA

Conversion angle $= \frac{1}{2}$ D.Lo. sin L_m

Mid-Lat.	Difference of Longitude										
	5°	10°	12°	14°	14°	16°	18°	20°	22°	24°	25°
°	°	°	°	°	°	°	°	°	°	°	°
5	0.2	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1
10	0.4	0.9	1.0	1.2	1.2	1.4	1.6	1.7	1.9	2.1	2.2
15	0.6	1.3	1.6	1.8	1.8	2.1	2.3	2.6	2.8	3.1	3.2
20	0.9	1.7	2.1	2.4	2.4	2.7	3.1	3.4	3.8	4.1	4.3
25	1.1	2.1	2.5	3.0	3.0	3.4	3.8	4.2	4.6	5.1	5.3
30	1.2	2.5	3.0	3.5	3.5	4.0	4.5	5.0	5.5	6.0	6.2
35	1.4	2.9	3.4	4.0	4.0	4.6	5.2	5.7	6.3	6.9	7.2
40	1.6	3.2	3.9	4.5	4.5	5.1	5.8	6.4	7.1	7.7	8.0
45	1.8	3.5	4.2	4.9	4.9	5.7	6.4	7.1	7.8	8.5	8.8
50	1.9	3.8	4.6	5.4	5.4	6.1	6.9	7.7	8.4	9.2	9.6
55	2.0	4.1	4.9	5.7	5.7	6.6	7.4	8.2	9.0	9.8	10.2
60	2.2	4.3	5.2	6.1	6.1	6.9	7.8	8.7	9.5	10.4	10.8
65	2.3	4.5	5.4	6.3	6.3	7.3	8.2	9.1	10.0	10.9	11.3

If the difference of longitude is greater than 25°, it may be divided by 2, and the tabular entry doubled.

From *Air Navigation, British Empire Edition.*

END

Grummans to Portugal

THE first of 12 Grumman G-21B military flying boats has been delivered to the Portugese government for use in that country's neutrality patrol. Canada has bought two Grumman G-21A amphibians, bringing the number of that type with the R. C. A. F. to four. They are being used as command ships for high-ranking officers and transportation of government officials.

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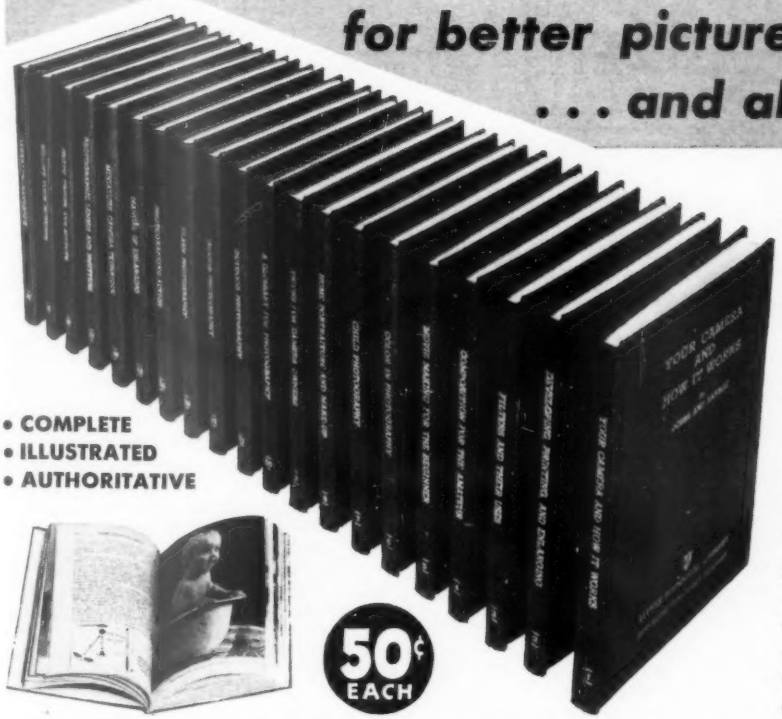

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The Sky's Her Limit

(*Continued from page 29*)

Making a pass at the airport, she suddenly found the airport's control tower looming out of the mist directly in her path. Yanking quickly on the stick and ramming wide open the throttle, she zoomed over the building, missing it by bare inches. Shivering from her narrow escape, she thought it over and headed for open country. She finally set down the ship in a tiny pasture and a couple of hunters hurried up to the ship, surprised to find the distressed pilot was a woman.

"Why," one inquired, "didn't you use your 'chute? Why didn't you jump and play safe?"

"Gosh," replied the aviatrix, studying the parachute absently, "I completely forgot about my 'chute. I was too busy getting the ship down."

Davis later bought a Beechcraft which Mrs. Davis mastered quickly, flying it in several races and spending hundreds of hours aloft in it, practicing precision maneuvers, blind flying, night flying, endurance and high altitude work until she gained perfection.

"What'll I do for excitement," she joked one day with Lieut. Donald W. Patrick, blind flying instructor at the Sundorph Flying Service at Cleveland airport, "when I get really good and don't need so much practice any more?"

"Learn to fly big ships," retorted Patrick. "There's always something to learn in flying."

"Say, that's an idea," rejoined Mrs. Davis. "There are plenty of girl flyers—but no girl 'big ship' flyers and we ought to prove that women can fly the big stuff as well as men."

She promptly signed up with Patrick to take 25 hours—at $60 an hour—in a tri-motored Ford, and quickly learned to wheel the huge, lumbering ship around the sky in verticals, eights and other maneuvers as lightly and agilely as in a *Cub*. Soon afterward she got a 4M rating—a rating permitting her to fly ships up to 25,000 pounds gross weight—on her private certificate.

Friends tried to talk her out of working so hard at flying, to devote more time to the garden parties, bridge-teas and other women's affairs. But that only made her more determined.

"I'll prove," she insisted, "a woman can fly anything a man can fly."

Mrs. Davis' test for her commercial certificate, taken from Harry Culler, Civil Aeronautics Authority inspector at Boston, was a real ordeal for she took all her ratings at once. That required four and a half hours of flying time all in a row and under the most strenuous conditions.

Starting off, she flew a *Cub* to get her Class 1 rating, then climbed into a Beechcraft and put it through the paces for a Class 2S rating, stepped into her Spartan monoplane to get a 3S rating and finally flew a Sikorsky S-38 amphibian, making both land and water landings to get her 4M land and water ratings.

Culler wrote into her log books this glowing tribute:

"Here's a girl who really can fly."

Arlene Davis laughs at—and resents, too—most men pilots' skepticism of the ability of most women pilots.

"Don't think any woman pilot ever got anything handed to her in flying," she ventures bitterly. "She's got to fight every bit of the way. Men may be chivalrous in anything else—but not in flying. Many of them—and especially some of the old timers among the inspectors—resent women in flying and a lot of them take the critical 'you show me' attitude toward women flyers. They'll demand a lot more precision and perfection from a woman than from a man. Believe me, you've got to fight every inch of the way—if you're a woman pilot."

Last summer she got the urge to fly in the Bendix Trophy Race and put in many gruelling hours of intensive training: hours of night flying, high altitude and even endurance flying, remaining aloft seven hours at a stretch in her Beechcraft to insure herself that she could stand the gruelling transcontinental trip. On one of these training flights, she got herself into a humorous situation—on her only forced landing. Intent in staying aloft, she ran out of gasoline on one flight and her motor quit. Selecting a nice field she made a good landing, then called the control tower at Cleveland airport.

"This is Arlene Davis," she informed the operator. "I've run out of gasoline. Please call my hangar and ask someone there to bring some gas out here to me."

"Where are you?" inquired the operator.

"Wait until I see," replied Mrs. Davis.

Carefully inspecting the surroundings and somewhat surprised that her forced landing hadn't brought the customary crowd of spectators, she suddenly found a wind sock hanging on an old barn. She had accidentally picked an airport on which to make her forced landing.

Her outstanding flight was in last year's Bendix race in which she was the only woman contestant. She took delivery on her sleek Spartan only a few days before the race, flew it to California and then captured fifth place in the race, flying coast to coast in 10 hours and 22 minutes. She also flew her ship to the All-American Air Races in Florida and to Nassau last winter.

Her biggest thrill in flying? It came not in the air—but in making a speech, substituting for Amelia Earhart in 1934 before the Federation of Women's Clubs Convention at Lakeside, O.

"Was I scared!" she laughs. "More scared than I ever was in the air. Amelia never knew in what a pickle she left me. I had never appeared to make a talk before, I talked with a Southern accent, wore a big picture hat and everyone took me for a school girl. But I got through."

She never finds any thrills in flying. "Flying is work to me," she explains. "I try to do the job as intelligently and as carefully and as thoroughly as possible—and I enjoy every minute of it. After 1,000 hours aloft, I still would rather fly than eat."

She feels that women flyers may play a very important part in any future wars, for there now are plenty of competent and experienced women pilots to instruct, fly transports, test and to ferry ships from the factories. "The only trouble is," she explains, "there aren't enough women experienced on the big ships. That's because few of them get opportunities to fly the big ships—but they may get those opportunities if the emergency comes."

Her pet peeves are those women flyers who go in for the outlandish costumes one sees at some of the air meets—those dressed in men's trousers or freakish flying clothes. "Every woman ought to keep herself as feminine as possible," she said. "That's the way men like 'em. I don't believe men flyers resent women flyers half as much as they resent the flying clothes some women insist on wearing. I always wear woman's clothes in flying—even in the Bendix. It's never necessary for a woman flyer to get blacked and greased up."

Another of her pet peeves are those who believe it takes a superman to fly. "It doesn't take a superman," she insists, "for there are no supermen. Anyone—man or woman—with ordinary intelligence and good sense can fly safely."

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'Chutes Are Safer

ARCHIE ATHERTON, Ryan School of Aeronautics parachute instructor, has made over 270 jumps safely. Recently he broke his foot stepping off a box.

Blimp Business

(*Continued from page* 38)

onto several circumferential rings. It is claimed that less than 1,000 parts would be necessary in the whole hull and cabin structure, thus doing away with the necessity of a complex system of girders, bracings and gas bags. The design calls for two alternative methods of propulsion: the conventional one with the power plants fastened to the cabin, or a new form consisting of a power plant in the nose of the ship. The latter method is known as displacement propulsion. It is effected by a large centrifugal blower on the nose of the craft. The blower draws a steady stream of air from in front of the nose and throws it out at an extremely high speed around the circumference of the blower. Air would be displaced ahead and replaced behind and the ship would be pushed ahead. It is reported that the United States Coast Guard and the Department of Agriculture are interested in the craft as a fire, relief and rescue ship. Prospects are not limited to this country; All-American Airways (the operating branch of the American Mechanical Engineering Company), in connection with Brazilian interests, plans to establish a 36-hour service from Washington, D. C., to Rio de Janeiro, carrying 100 passengers for about $300 each.

Leaving the metal-covered airship field for a moment, let us take a brief look at the only other concern besides Goodyear-Zeppelin which advocates construction of a fabric-covered airship. This company has attracted much attention and is well-known to many members of Congress. It is the Respess Aeronautical Engineering Corporation, headed by Roland B. Respess.

The design fostered by this concern is not as radical as some that are submitted by other airship companies; it resembles Zeppelin construction in many ways. Keeping the Zeppelin type in mind, Respess has developed the idea of employing the self-anchored suspension bridge principle in the construction of airships. The conventional type of dirigible hull consists of a system of polygonal transverse frames or rings joined by a number of uniformly-spaced girders which run longitudinally along the length of the ship. The design offered by Respess engineers retains the series of polygonal frames, but for the longitudinal girders it substitutes a system of wires under tension. Still another departure from the conventional airship design is the use of a center spar which extends the length of the ship and to which the ends of the longitudinal wires are fastened. Most other conventional items—cross-bracing by shear wires, the use of gas cells, etc.—will continue to be employed.

Meanwhile, there is still another concern advocating the metal-covered airship. It is the National Airship Association of California, headed by Thad Rose, designer of this ship. It is a craft differing radically from accepted design; the National Airship Association now has the prototype under construction. Incidentally, it is the only company in the U. S. building a dirigible today. This ship incorporates a main power tube running horizontally through the center from one end of the ship to the other. This metal tube passes through a series of rigid metal gas containers that are joined together on the outer circumference for longitudinal stiffness. A metal envelope is placed over this framework. The horizontal tube accommodates two engines, one near the bow, the other near the stern. Purpose of this center motor tube is to relieve air pressure at the ship's nose so that a vacuum may be created into which the craft slips, helped along by the rear motor in the tube. Forward motion is aided by engines mounted on the outside of the craft. Rudder and elevator controls are mounted on the tube at the extreme stern of the dirigible. In addition to the center tube there are two vertical tubes. One is a short distance from the bow, the other near the stern. These tubes each have individual engines at the lower opening. As the center tube is for horizontal flight, so the others are for vertical flight. It is argued that the vertical tubes eliminate the necessity of carrying ballast and enable the craft to descend vertically and land without the need of a ground crew. The nose and stern of this dirigible have a curvature angle of about 60° at

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both ends, making the main section practically parallel and of the same dimension throughout until the curve is reached at the ends. Because a speed of about 200 m.p.h. is claimed and low cost both in construction and operation seems probable, it will be interesting to watch this craft; its success would advance present-day concepts of airship design.

Lastly there is the Inter-Ocean Dirigble Corporation, still another company advocating a metalclad type of airship construction. First organized in Richmond, the firm was known as the Virginia Airship Company. The Inter-Oean design is similar to that of the National Airship Association in that it incorporates a central power tube. The power tube running through Inter-Ocean's airship contains four Diesel air-cooled engines, the power plants of the ship. Flight control of the craft is not maintained by rudders or elevators but by means of a special nozzle at each end of the tube. Arranging the nozzles so that air is drawn into the tube from above and ejected from the rear nozzle in a downward direction, the ship naturally rises. The relative positions of these nozzles enable control of the ship in any direction. The ship's general shape is short and stubby; at last reports the company was planning to build a 1,000,000 cubic foot airship capable of carrying 40 passengers at high speed.

Such is the airship "industry" of today. It is a young and undeveloped industry—undeveloped because of lack of financial backing either from the Government or from private capital. The airplane has been well subsidized, while the dirigible is almost entirely neglected. The United States, with its monopoly of helium, has yet to exploit the commercial airship. However, developments in Washington indicate increased activity in the rigid airship field. Perhaps some time soon the airship industry will come into its rightful own.

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AUGUST ISSUE

RADIO NEWS

AT ALL NEWSSTANDS

Dilemma

(*Continued from page* 42)

apart, the front wheel out ahead about 15 feet. And Vega was no piker—for the contraption weighed more than three tons!

A "pilot" rode on the nine-foot high tricycle. He applied brakes on first one wheel and then another; let the thing roll onto steel plates thoroughly coated with grease after a speed of 50 m.p.h. had been attained and the tow car cut loose, allowed it to leap, buck and skid. All during the weeks of testing delicate instruments recorded various phases of performance and the engineers ordered corrections and adjustments.

Yes, they laughed and ridiculed that Hammond "Y" when it first put in its blunt-nosed appearance on 100 fields. But later, while Lockheed and Vega were testing for the *Starliner,* and for the big, four-motored *Excalibur,* another manufacturer got busy. That was Bell.

The Bell report states that shimmy was the greatest problem faced in getting a nose wheel into the *Airacobra* design. But, as did Vega, Lockheed and Douglas, they licked it much the same way. Bell engineers spent $50,000 in development work over a period of eight months in 1937. They, too, built a test car weighing three tons and with the same center of gravity as the plane they proposed to build. It was towed at speeds of from 60 to 70 m.p.h. It was run on concrete and macadam roads, wet and dry, on grass and through mud, over ice-crusted runways, off the edges of runways, on soft shoulders and into deep ruts. Brakes were operated all at one time, one at a time and two at a time. The nose wheel construction was checked additionally by packing parts in dry ice and by heating with blow torches. Speedometers, stop watches and motion picture film caught the record.

In the end there was no shimmy! And the tricycle went onto the ship!

But what of the private owner and the ship he might like to buy? Waco was first in the medium weight class. And this is what Waco's spokesman has to say of the career of the famed "Model N":

"Our development was accomplished by using an actual ship and moving the wheels until we got what we wanted," declares H. R. Perry, in charge of sales. "Otherwise, our experiments were much like those of other companies. 'Our reason for developing the tricycle landing gear for our own use was its inherent safety. We realized the naturalness of such an airplane compared with an automobile, particularly in taking off and landing, whereby the necessity of putting the airplane in what to a novice would be a flying position to take off and a flying position to land would be eliminated. Our secondary reason was a feeling that we could reach with this airplane *a market of those who through natural ineptness or a mild fear were refraining from aviation activity due to the skill required to fly a conventional airplane.*"

Waco turned loose about 40 men at various times to aid in the development. Testing was done by John Livingston, of racing fame. Perry says:

"The advantages of the landing gear have been just what the industry expected of it and they have proved very satisfactorily in operation. You can land it on an airport in a wide variety of awkward positions and have it in all cases place itself properly on its three wheels after any one of the three hits the ground and continue in the selected line of travel."

Perry enumerates the reasons for the period of dormancy as given by Douglas and adds that shock absorber development had to come to its present advanced stage before tricycle landing gear became practical.

Has the Waco experiment to aid the private flier proved practical? In other words, has it paid off?

Emphatically. Perry reports the sale of 22 "N's" ranging in price from $13,000 to $18,000. Practically all have reached the market Waco hoped for. Many men who have learned to fly in middle age have wanted such a ship for years. It has proved a confidence builder and has got them away from home airports and into cross-country work for they know that they'll be safe in cross winds, on strange airports and that if an emergency landing becomes necessary they can stop almost immediately after ground contact.

"The next two steps forward," Perry predicts, "will be lower priced models and nose wheels on light airplanes which will be retractable."

The "N" has not confined itself to the sphere of private flying. The C. A. A. has been using the ship extensively in blind landing tests. Progress has been made which without the tricycle would have been impossible, those involved report. And the British Air Ministry has purchased an "N" which has been used for study and guidance in British tricycle landing gear development. Yes, it's catching on there, too, in the middle of a war.

Hammond, the man who started it all, says:

"Don't give me all the credit. The tricycle is not new. Some of the very old planes had skids and even wheels at the nose. The wheel was simply incorporated in modern, useful form in the 'Y'. After the 'Y' was produced and flying and even before, I ran into other places where it was being thought about and tried. The 'Y' was, however, I believe, the prototype or demonstrator for the idea. It was the first to get an A. T. C. It wasn't a one-

man job either as I sought information from every nook and corner available."

That's probably the way it was, if the modest Hammond says so. However, it's still necessary to credit him with the adaptation of an old idea to a new form, putting it on the modern plane and making everybody from tyro pilots to the ace test men happier. It's here to stay.

END

Stainless Steel

THE iron alloys committee of the Engineering Foundation reports that aviation is providing a new market for stainless steel. The research agency says the trend is expanding to the lighplane field with several manufacturers specifying stainless steel rudders, stabilizers, elevators and fuel tanks. Although it is heavier than some alloys now used in aircraft, the committee asserts, stainless steel compensates for this disadvantage by being stronger. This additional strength, in conjunction with its corrosion resistance, enables it to be used safely in many thin sections, equalizing the weight of the completed structure. Several types of European military planes are using stainless steel for standardized parts.

Install Monorail

TO step up production facilities in the *Cub* factory, Piper Aircraft officials have borrowed an idea from the automobile manufacturers. A monorail system to improve straight line production methods has been installed over the entire first floor of the Lock Haven, Pa., plant. Hanford Eckman, factory superintendent, estimates that elimination of wheel jigs and use of the monorail system will speed production 15 per cent.

Allied Flivvers

(*Continued from page* 34)

out for England and France. The harbor is magnificent and in addition there is the inner basin which is completely landlocked (except for a narrows leading to the protected harbor) about 50 miles around and has a uniform depth of more than 1000 feet. The basin was right beside the open corridor as we flew in and most of us counted more than 60 vessels anchored there waiting for the next convoy.

Across the harbor from the town was the military airport. From it Canadian boys with less than 300 hours of flying time operated Douglas B-18 bombers—they call them *Digbys*—on patrol. These aerial patrols go as far as 1,000 miles to sea. In addition, they use a twin-engined Supermarine biplane called the *Stranraer*. These boats are slow but ideal for convoy work for that very reason.

"A couple of weeks ago one of the *Digbys* saw a submarine floating just under the water about 100 miles out on the route to be followed by a convoy scheduled to get out next day," one naval official told us. "They circled overhead and called the destroyers by radio. They dropped a salvo of depth bombs on the sub and a huge spot of oil came up on the sea. We think they got her. Anyway the convoy went out on schedule but was never bothered."

The Canadians say they are constantly being amazed by the excellence of the Nazi espionage. They said that several times they have had convoys go out as secretly as possible and yet had German radio announcers from Berlin announce the same evening that the convoy had left and identify correctly every vessel in the group. They can't explain it but say it's more evidence of German thoroughness of preparation.

None of the Canadians seem worked up over the war. They say that they'll win in the end if the United States can continue to supply airplanes. They say that they'll need more all the time. They also say: "We're not worried about what happens in France now. We'll not be ready to give the Germans a good whacking for another two years. Then we'll really be set and watch us go. We're just hoping to hold them now."

Their great shortage is pilots. We talked to several young pilots who were taking an instructor's course at the Aero Club field. One of them, a lad with 90 hours, said that half his class had been killed at Camp Borden, the only Canadian Randolph Field that is functioning yet. He said that all his time had been on 550 h.p. airplanes or 1,030 h.p. planes. He admitted he was "hardly dry behind the ears" as far as flying was concerned but there he was getting ready to instruct.

The great Canadian training scheme is set to get under way some time next fall after 25 great camps have been organized, equipment purchased for the training program and instructors obtained. At the moment the Canadian government is guaranteeing $3,100 a year (Canadian money), to instructors.

Before we left we learned that the Belgian government's order for Brewster fighters is being delivered now to the French. The Brewsters, in crates, were being loaded aboard the aircraft carrier with the "105s," and the carrier was to be escorted back to France by a light battle cruiser that was tied up at a dock alongside the carrier.

Just before we left Halifax a ship with a terrific list to the port side negotiated the narrows and anchored in the inner basin. She was camouflaged and disguised. At the distance from which we looked we couldn't tell but the story soon spread round that she had been attacked at sea on her way in.

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We couldn't prove it but we believed the tale.

One last point. The Aero Club field was heavily guarded by a permanent detail of Tommies. There were machine gun strong points heavily banked with sandbags at every gate. The guns were set up to sweep either the entrances or the field itself. On two hills within the airport fence were heavy anti-aircraft cannon. And on one hill was a shed described to us as the entrance to an underground ammunition dump.

The harbor is defended by batteries of 8 and 11-inch guns. They are well concealed but laid to cover all approaches and to fire well out to sea. None of the Norwegian sleepiness or treachery here, say the Canadians. Any German ships that try to force that harbor will "catch it." Finally we heard that several big battlewagons that had been at Halifax have gone to the South Atlantic where, it is said, another armed German raider is busy. The battle wagons are tracking her down. They expect to hear of another engagement like that of the *Graf Spee*.

The pilots, each of whom flew a "105" to Halifax, included Nancy and Bob Love of Boston, Mass., B. D. DeWeese, Jr., Evanston, Ill.; Keith Davis and C. Amas Parker, Boston; J. F. Hoffman, Toledo, O.; Wayne Thomis, Western Springs, Ill.; Homer Stockert, South Bend, Ind.; Charles T. Lodwick, Indianola, Ia.; Charles L. Sharp, Fairfield, Conn.; Fred L. Eldridge, Albion, Penn.; Jack Keaveny, Wilmington, Del.; Robert W. Coverdale, Fairview, Penn.; Francis G. Drake, Jamestown, N. Y.; William Wheeler, Buffalo, N. Y.; C. K. Rexrode, Washington, D. C.; Frank Schwikert, Rochester, N. Y.; Tom Davis and Joseph W. Brooks, Winston-Salem, N. C.; Mike Stehle, Memphis, Tenn.; W. H. Klenke, Jr., New York City; C. Arnold Renn, Washington, D. C.; Edgar B. Grear, Jackson Heights, N. Y.; John Burkle, Kansas City, Mo.; G. P. Wilson, Mobile, Ala.; Peter Grim, Jr., Staunton, Va.; P. E. Hostetter, Harrisonburg, Va.; Cy Younglove, Nashville, Tenn.; Tony Bastone, Mineola, N. Y.; Ben Mangina, Birmingham, Ala.; Myrl Brode, Akron, O.; J. L. Sutton, Buffalo, N. Y., and Robert Koleman, Toledo, Ohio.

END

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The Airlines

(*Continued from page* 67)

justified in the interests of public convenience many others show distinct tendencies of chiseling. Sensible competition can be a healthy condition, but whenever it promotes undue rivalry someone is bound to suffer—usually it is the public.

Another year will surely witness the advent of four-engine transports on most of the major airlines. This will be the first radical change of flying equipment since the present type of two-engine transports was placed in service during 1934. Although a great deal of wisdom has been gained from past experience that may be applied directly to the operation of this new equipment many new problems inevitably will present themselves. If they are to be operated safely, it is to be hoped that every reasonable effort will be made to familiarize all pilots and flight control personnel thoroughly with their flying characteristics before too ambitious operations are attempted.

Despite these few threatening clouds on the airline horizon any impartial observer of the situation cannot find much to cause justifiable alarm. With the general economic condition of the country apparently in the ascendant the airlines are in the most favorable position of their history. Years of struggle have at last been rewarded with profits. Of all the contributing factors no one can question the preemience of safe operation in establishing public confidence. It is to be sincerely hoped that no airline operator will ever neglect this modern Aladdin's lamp—Safety.

END

Flying Farmer

DELMAR H. WITHROW, Greenbrier County, N. C., farmer, flies produce, eggs and chickens to market in White Sulphur Springs and other places from his mountainside home by *Cub*. Roads to his farm are closed to transportation about 10 months of the year. Withrow once spotted some young pigs he liked on a farm he was flying over. He landed, bought them, put them in a sack in the back of his lightplane and flew them to his home.

Yankee Warplanes

(*Continued from page* 18)

anti-aircraft guns were the laughing stock of the war makes it look as though the Europeans have a point there.

Another war lesson is the need for practice in landing on and taking off from rough fields minus runways. Large, well-prepared airports are pretty conspicuous, camouflage to the contrary and besides take long enough to prepare so that there is a better-than-even chance that the enemy will know where they are anyway. In other words they are a standing invitation to bombing. Under actual war conditions frequent shifts and operation from ill-prepared fields are necessary. American pilots would do well with a bit of cow pasture work. Those nice easy runways won't always be there.

Still another headache into which Air Corps experts might look is identification of planes. Unlike the last war when much action, particularly that involving bombers, took place around 15,000 feet or below there is little activity now below 20,000 feet. At 20,000 feet all low-wing monoplanes look alike even through field-glasses except to the most practiced eye. During one three-day period when members of one British squadron kept track out of idle curiosity, 40 per cent of flights from its field were made in order to identify that noise and that object overhead. The noise in each case proved to be returning ships belonging to that squadron. The famous nine against 27 series of air battles between Curtisses and Messerschmitts began because a returning *Hurricane* pilot mistook nine Messerschmitts for craft from his own squadron. He flew over to join them. Both sides then discovered the other's correct identity and the Messerschmitts lit out after a *Hurricane* pilot who had no choice but to flee. French pilots, lurking at the scene of the chase by accident, dove on the Messerschmitts. The story might easily have had a different ending. When the war first began both sides carefully obliterated identification markings. Small ones were soon put back on. Then larger ones. Now they have biggest marks possible.

There are thus two sides to America's interest in Europe's air war: our ships—they're doing fine—and what we have to learn. This last is a subject whose surface POPULAR AVIATION'S correspondent has only touched at this time. The eyes of American aviation leaders are turned more sharply and more penetratingly Europeward today.

END

Dressing Room

BECAUSE of the swift change between climatic zones for passengers bound from northern cities to South America during the winter, the Miami air terminal has installed a men's dressing room and shaving parlor to permit passengers to change to lighter clothing and freshen up between flights. Northbound passengers also find it handy to change to heavier clothing en route to northern cities.

Kite Studies

(*Continued from page* 53)

projected area of the kite in square feet, V the velocity of the wind in feet per second and the forces in pounds. In case the wind velocity is given in m.p.h. it is multiplied by 1.467 to get the speed in feet per second.

Selecting other points of attachment for the line new resultants will be obtained. Locating these resultants for various angles of attack on the kite a vector diagram similar to the one shown in Section 4 may be drawn.

Usually the determination of the wind speed is the only problem to be encountered. It may be obtained from the Weather Bureau or measured with an anemometer. A simple wind speed indicator is sketched in Section 4. Its size is 2 inches by 5 inches. It may be folded and carried in a vest pocket. It is a homemade affair. A wire frame supports a hinged plate that swings out depending on the velocity of the wind. The indicator is calibrated on a car traveling at the speed at which the dial is to be marked off.

The height a kite may reach with a certain length of line is indicative of its qualities. The height may be calculated with the formula given in Section 5 if the length of the line and the two angles are known. The formula is based on the assumption that the line follows an arc of a circle. More exact is the method shown in Section 6 that uses two points in line with the kite from which the elevation angles are measured. The distance between the observation points must be known. For estimating purposes the average lift and the average tension on the line may be found with the formulae given in Section 6. A denotes the projected area of the kite and V the wind velocity in m.p.h.

The wind speed will limit the height to which a kite will rise with any length of line for the additional line will only rest on the ground (Section 7). If such is the case and the line breaks on the lower end the kite may travel for great distances until the line gets entangled or the wind dies down. By joining kites together higher altitudes can be reached. Three systems of coupling kites are illustrated in Section 7.

Meteorological instruments may be sent up for automatic weather recording. If a camera is attached to the kite line means of dampening the oscillations must be provided. A spider frame made of bamboo rods with lead weights on their outer ends will give the necessary stabilizing effect. The shutter is released by a timer or a string that starts the timer. Kites are built to carry observers. Their use for observation purposes is only reliable if launched from a moving airplane which insures the relative air speed required to support the observer.

Not only kites but also gliders or airplane models can be tested on a line to find their aerodynamic characteristics. Section 8 shows a test conducted by the Wright brothers. It eliminated much of the guesswork so often required in experimenting without laboratories.

Designs of kites are shown in Section 9. There are two distinct groups of designs, the surface and the box kites. The design of the surface kite usually resembles the all-wing airplanes; usually a tail must be added to obtain the necessary stability. Greater lifting power and better stability is achieved with box kites which closely resemble the biplanes of early days. They may be rectangular, square, triangular, cylindrical, hexagonal or cellular cross section. A combination of both flat and box designs will give the highest efficiency. Streamlining the exposed frame work will add to efficiency.

In Section 10 a few kite details are shown. Covering with tissue or heavy wrapping paper and cambric if cloth covering is wanted are the most popular methods. The size of the wooden frame is for a five-foot box kite about ⅜ by ¾ inches. For long lines a reel must be used and to keep the tension in the line a spring or a rubber cord is inserted at the lower part of the bridle as sketched in Section 10. Testing kites, gliders or airplane models in this way is a simple method of studying aerodynamics without a large investment in instruments. So if you would like to start in aviation from the ground up—go fly a kite.

END

Parachute Instruction

CADETS at Randolph Field are receiving parachute instruction in a harness suspended from the ceilings of both parachute departments. The instruction is designed to illustrate how a parachute harness should fit, not on the ground or in the cockpit, but when the 'chute is in use in the air. Instructors said the apparatus enabled the students to learn how to sit in the harness seat rather than remain suspended by the leg straps after bailing out. Demonstrations are included on how to leave the 'chute and harness when making a descent into water.

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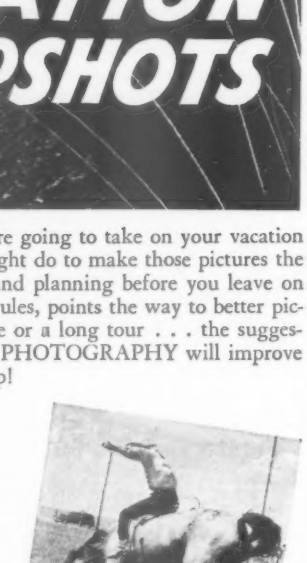

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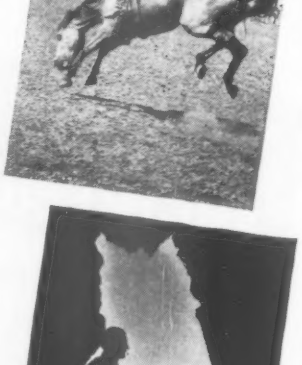
☆ **POPULAR PHOTOGRAPHY** can help *you* get the most out of your camera this summer. The August Issue is bubbling over with vacation talk . . . helpful hints that will make your shutter finger twitch! Expert photographers tell you how to plan your camera vacation; avoid common mistakes; take dramatic urban shots; film the youngsters; capture garden, marine and desert pictures. Yes, camera fans, you're missing too much if you miss the big, colorful



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I Learned About . . .

(*Continued from page 39*)

shouted to me, "Come on, Clev, do a few stunts on the way down. It's lots of fun!" The wing-walkers only flew during a show and Gates always kept them working hard on the ground loading on gas and oil or working on the motors or selling passenger tickets and handling the crowds. It was like a vacation to them to get up in the air and walk the wings and ride along during the aerobatics and they always enjoyed it.

We pilots always strive to please so we did a flock of loops, Immelmanns, rolls, reversements and falling leafs on the way down to the approach for the landing. That stirred me all up again and by now I had such a tired, sick feeling that I hardly knew or cared whether I was in an airplane or a row boat.

As we were gliding in at about 50 feet, the wing-walker again shouted, "Aw, come on, Clev, show the boys at the field how to do a whip stall landing." I should not have done it, but I guess it was best in the long run that I did for I learned a valuable lesson.

I "poured on the coal" and dove at the ground to put on speed. I had done hundreds of whip stall landings and always with precision. Besides that I had flown six years as an exhibition stunt pilot without ever cracking up and I just didn't think it could happen to me. In those days we used to watch generations of pilots come and go to the ultimate job of pushing up daisies and we pilots, who through ability and luck had survived, got the false notion that we had charmed lives.

As I touched the wheels I throttled the motor as usual and zoomed the ship straight up into a stall. I hardly looked out at the peak of the stall and as the ship swooped down I rounded out the dive, coming out at about 15 feet. All this time my reactions were slow and groggy although I did not realize it at the time. I looked out and saw I had a lot of room ahead of me.

I noticed the wing-walker clapping his hands as he was thoroughly enjoying himself. Then I made a fool misjudgment without second thought. I decided to make another whip stall before landing. Two in a row never had been done.

Without realizing that I was mentally and physically groggy in my reactions and unable to judge flying speed with my usual touch, forgetting that I was not in a position to dive and pick up extra speed, I "poured on the coal" again for a minute and yanked her up in a stall. I didn't even look out as the ship lost all speed straight up and started to whip over towards the ground. As it headed straight for the ground I looked out expecting to be up 150 feet or so—but I was only about 100 feet up coming like blazes. That snapped me out of my lethargy—but too late.

I popped on the motor and tried to level out and catch it, but I lacked about

15 or 20 feet of altitude to get away with it. The plane just mushed and squashed right on into the ground in three-point position with the motor wide open. Luckily it didn't catch on fire.

The sudden stop was quite a jolt but luck was with us and neither one of us were hurt much. The wing-walker had the foresight to draw his feet up away from the floor, saving them from being crushed under the gas tank. The ship just spread out like an old hen sitting on her eggs. The wings settled down to each side, the tail bent down to the rear and the motor mount snapped off leaving the engine resting nose down on the broken prop.

I was indeed one surprised boy! I just sat there and thought: "Well, I finally cracked up an airplane for myself!" We rebuilt the airplane and it flew many more miles as an honorable work horse. I found a good doctor and recovered from my illness, but I have never forgotten the lesson I learned in St. Louis.

An experienced pilot gets into the habit of flying various maneuvers on the "ragged edge" of losing flying speed and than picking it up just in the nick of time; all very safe and very pretty if done in accordance with his particular touch and feel of flying. However, if he is ill in any way, his sense of touch and flying feel is not as accurate.

Since then, I have seen many cases of experienced pilots "signing off" by way of an accident caused by flying with customary gusto after a siege of illness when their precision was not tops due to poor physical condition.

The moral is that if you are not "up to snuff" physically and mentally, take it into consideration and tone down your flying or don't fly at all. Be an "old lady" until you feel better.

END

Long Range Repairs

IT'S a long way from New Guinea to Cheyenne, Wyo., but propellers on airplanes which operate between the "down under" island and Adelaide, Australia, for the Bulolo Gold Dredging Corporation will be repaired at United Air Lines base at Cheyenne. Superior workmanship in America was cited by the New Guinea company for shipping its propellers 10,000 miles for repairs. The airline is the only contact between the almost inaccessible mines and civilization.

New Post Office

TINY Canton Island, 4,316 miles from San Francisco in the South Pacific Ocean, has the latest U. S. post office. Canton, 1,912 miles southwest of Honolulu and just below the equator, will be the first stop on the planned air mail route from Honolulu to Auckland, N. Z. Another stop also will be made at Noumea, New Caledonia, about 1,200 miles southeast of Canton Island. The new service will connect San Francisco and Auckland via the San Francisco-Honolulu leg now in regular operation.

Plotting Ace

(*Continued from page* 15)

most famous flights—from Earhart to Cochran.

This was his job, as he explains it today: "We 'map-fly' a dangerous route months before an expedition's takeoff, to reduce guesswork to the vanishing point." Commander Williams' system can best be described by outlining a hypothetical case.

Take Madagascar. Here's a French island just off the coast of East Africa to which nobody, probably, ever would care to voyage by air. Between Los Angeles (where the commander lives) and Madagascar lie about 15,000 miles of unpacified Pacific Ocean, myriad little atolls, the Philippines, India, the shark-ridden Indian Ocean through which infrequent Calcutta-Capetown steamers ply. But Commander Williams will direct you thither. He might even accompany you—if he deemed your aircraft suitable for the grueling flight. . . .

"Madagascar?" he asked, thinking hard, his eyes staring at a non-existent globe. "Certainly." Then he ruminated aloud. "Would take a pretty good plane. Say a Consolidated PBY with a 3,000 mile range. Probably best to head west over Pan American's route to Manila. At least," he said, "we have *that* much already charted for us."

Roughly, the commander sketches-in the course. He blocks in the skyway to the Philippines, down through the South China Sea to Singapore, then in a brisk semicircle west to Ceylon. Till now the process has been as simple as opening your pre-Munich atlas. Then the going gets tougher. After he establishes his main ports-o'-call along definite air-routes where gasoline and repairs are available, Commander Williams sets about the actual map-making.

Outside of the United States Hydrographic Office, he said, three sources exist where detailed maps of the world and all its outlandish components can be purchased. These, assembled like a motorist's set of "strip-maps" for a drive from New York to Kansas City, provide the basis for the eventual flight charts.

First of all, the commander considers his overwater hops. Take, for example, a portion of the journey over which no radio facilities help the pilot: the jaunt from Honolulu to Manila. Pretending that the earth is a round, red apple, the chartmaker slices a line between these two cities, thus dividing the fruit into equal parts—or hemispheres. This line represents the Great Circle, because it is the circumference-course cut by the knife passing through the apple's (earth's) center.

On the surface of the world, the Great Circle is a straight line; on the charts which eventually result, it is shown by a curved line. Yet it is the shortest distance between the two points—Honolulu and Manila.

Naturally, even the smartest pilot couldn't fly this curved chart course. Thus when the line has been drawn on the map, Commander Williams must locate the points along the chosen route where the airplane's flight-direction must be altered.

So the pilot's true course approximates the Great Circle with a series of short, straight flight-segments called "rhumb lines." At the end of each, the airman resets his compass to head his ship in a slightly different direction. Accurate Great Circle flying is quite a trick; course-changes must be made on the dot. For this reason, Dick Merrill and Harry Richman carried an alarm clock on their 'round-trip to England. When it rang, Merrill shifted the compass needle. At 150 m.p.h. over a 75-mile segment, for example, they changed precisely on the 30-minute signal.

Commander Williams charts the whole course in this fashion. He makes one master map of the whole flight, then splits the course-as-a-whole into sections that may represent a day's run or a simple hop from one airport to another. Some are reproduced photostatically on easily-handled cards for cockpit use. Each "strip" contains invaluable information about prevailing winds, weather and landmarks which can be used.

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MONKEY BUSINESS

So you think you have troubles, eh? Well, how would you like to play host to over 600 monkeys seven days a week from early morning to near midnight? Had you all these monkeys you'd probably say, "What can I do with all these animals? Gosh, guess I'll have to go in business!" And that's exactly what a group of men have done in Hollywood! Don't fail to read all about "Monkey Island" . . . the home of one of the largest collections of Rhesus monkeys in the world! You'll find this entertaining article by Frank Cunningham in the August PETS!

I TRAIN VICIOUS DOGS

"They don't come too tough for me" . . . a boast that brought Michael Motzeck a reputation as an expert trainer of vicious dogs. Hazard, a 90-pound ill-tempered German Shepard; a pit bull terrier, the canine Joe Louis of the midwest; Jiggs, a terrifying Great Dane; a "hypnotized" Doberman Pinscher . . . these are just a few of the scores of vicious dogs von Motzeck has taught to be peace-loving canine citizens. This noted dog trainer demonstrates the amazingly complete control which may be obtained over a dog's mind through proper training methods.

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There are twenty other great features and articles in the August PETS you will also want to read . . . good, sound, and intensely interesting information about pets of all kinds . . . all brilliantly illustrated and ably written by the foremost authorities in the pet world. Make PETS, the only magazine of its kind on earth, a "must" twelve months of the year. Start with the

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NOW ON SALE At All Newsstands

Next the commander writes a book! This is not strange. For the volume he pens is just about as essential to the safe outcome of the flight as the maps themselves. It gives, in readily accessible, digested form, data on every aspect of the weather expected at this particular time of the year at any specific place on the course. If monsoons are common in a locality, he describes exactly how these tricky winds blow. To the last drop, fuel supplies are accounted for and mechanics are spotted along the right-of-way.

Finally, like a good football coach, he puts his crew through a stiff training period. He remembers—and quotes—a veteran pilot who once told him: "The average flyer fills his ship with enough instruments to navigate a battleship—and then hedgehops along a railroad track." For this reason his skull drills are humdingers. Commander Williams feels that most pilots look somewhat disdainfully at navigation as a science.

The only time he will permit his pilot to deviate from the plotted course is when storms brew. But in his instruction book—as well as on alternate flight-paths on the strip- and master-maps—are ample guides for zigzagging around typhoons or what-have-you. The flyer steers by zones, three of which lie between Oakland and Honolulu on the Clipper route. His prevailing winds and meteorological data in the handbook thus easily may mean the difference between life and death to the adventuring airman.

For example the *Graf Zeppelin,* on a westward Atlantic crossing, once was bumbling up from the Azores on its way to New York. Into its radio suddenly came the report of a hurricane heading up the coast toward Cape Hatteras. So wily old Capt. Hugo Eckener struck out to the northward for Newfoundland. Then he changed his course and, aided by a 70 m.p.h. tailwind, scurried into Gotham *faster* than he would have sped had he followed the shorter path.

Winds are no joke in Commander Williams' business. They cut down flying time, help eat through precious gasoline reserves on a long overwater junket. . .

A thousand-and-one variable factors concern him in plotting an expedition's route. His handbook, concentrating on logistics, deals in personnel, airports, transportation—even civilization itself. This last was pretty important to Amelia in spanning Africa in 1937.

He spares no exertion to crown his efforts with success. Until Amelia's tragic flight ended in silence somewhere near Howland Island, he had never experienced failure. Actually, this unhappy voyage foundered through no fault of his. He whips his pilots through practice distance flights. One woman, planning a lengthy journey, was instructed to navigate the entire trip over a "miniature route," practising Great Circle flying and making the course changes she might have effected over Moscow or Bucharest. In fact, however, she executed these maneuvers over Salt Lake City and Denver!

"Long distance piloting," the commander says, "is like building a home—and every bit as cut-and-dried. But like the wise contractor, the airman must follow his blue-prints—his charts with the course of his flight plotted on them."

Accuracy is the soul of Commander Williams' work. Nowhere is it better exemplified than in plotting a speed record course under F.A.I. rules. Take, for instance, a 1,000-kilometer run. Today such a trial is timed "on the wing" with theodolites at the end of each 500-kilometer leg. For this task, whole new standards of accuracy far beyond the range of mere navigation must be observed. This was the procedure Williams outlined and followed in providing such a course for Jackie Cochran when she hung up a 305 m.p.h. mark:

From the Coast Geodetic Survey he obtained the location of a point within one-tenth of a foot of a certain intersection of latitude and longitude. Swinging his calipers on a globe, with this jot near Burbank, Cal., as his basis, he then found an approximate point 500 kilometers northward. Surveyors narrowed this down to a spot equally as precise as the geodetic engineers' own location of the first spot outside Burbank.

To compensate for the earth's curvature he recalled grimly, he resorted to *eight-place* logarithms!

Naturally, the transcontinental races are simpler courses to chart. From his effort of nine years ago, when he plotted a coast-to-coast speed run for Colonel Turner, Commander Williams has advanced to a degree where he makes his own strip-charts for the Bendix Trophy dash. His navigational instructions, he believes, would enable a pilot to wing his way from Los Angeles to Cleveland *absolutely blind*—yet hit that city "on the nose."

END

AOPA News

(*Continued from page* 50)

proportions when one transported it many miles from the distribution point. Chief problem of this type of building is the roof truss we found. In addition to the engineering problems of preventing sagging doors, the expense of this item in some of the plans we surveyed amounted to a third of the total cost. A second problem was that of doors. Most operators have complained about the doors of their hangars. They either freeze in the winter or become sprung in high winds. Both conditions make the doors difficult to operate.

To sum it all up, we could not find an existing design which, in our opinion, was reasonable enough or which was structurally as good as we thought it might be. AOPA now has several people drawing up designs for this type of hangar. We have been encouraged recently by a report from one of our architects who reports definite progress and the inclusion of what he calls engineering principles that "have not been used before in this type of building." We'll give you more on this as our plans develop.

END

First Stewardess

THE stewardess idea was a coincidence of thought, the nation's first air stewardess believes. Miss Ellen Church, now teaching supervisor of the department of pediatrics of Milwaukee County Hospital, Wauwatosa, Wis., became interested in flying 10 years ago. She took flying lessons and wondered whether she could combine her nursing and piloting experience for ambulance flights. Visiting S. A. Stimpson, United Air Lines' traffic manager at San Francisco, to discuss her idea, she heard of the line's San Francisco-Chicago schedules with the then new Boeing 80A tri-motored transports. As Stimpson explained the flights, Miss Church recalls, she thought of the stewardess idea. A little later in the conversation Stimpson hit upon the same idea. Officers of the company agreed to try stewardesses and Miss Church made the first flight, between Chicago and Cheyenne, May 15, 1930. Seven other stewardesses were employed at that time. Senior stewardess in active service today is United's Clara Johnson who enrolled March 26, 1931. Now on the Seattle-San Francisco-Los Angeles-San Diego division, she has logged over 1,000,000 miles.

License Summary

FIGURES in the following table, supplied to POPULAR AVIATION through special arrangement with the Civil Aeronautics Authority, cover the aviation industry in the United States as of May 1.

Total pilot certificates of competency, active	33,740
Airline pilot certificates of competency, active	1,203
Student pilot certificates, active	34,362
Glider pilot certificates of competency, active	149
Mechanic certificates of competency, active	10,209
Parachute rigger certificates of competency, active	420
Certificated aircraft, active	12,829
Uncertificated aircraft, active	495
Certificated gliders, active	39
Uncertificated gliders, active	83
Ground instructors' certificates of competency, active	692
Air-traffic control-tower operators' certificates of competency, active	225

Pays With Furs

DR. BART LARUE, a dentist of Ruby, Alaska, used a pair of matched cross fox furs as part payment on a *Cub*. Dr. Larue offered gold dust and nuggets as well as a huge bundle of ermine skins in trading with Art Whitaker, Portland, Ore., distributor. He explained that his Indian, Eskimo, trapper and miner clients paid his fees in gold, furs and even smoked fish. He will use the airplane instead of his dog sled to cover his territory.

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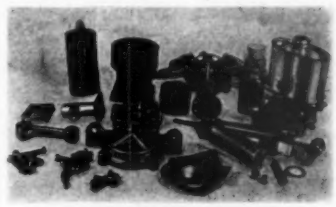

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DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
AERONCA				
Portland Flyg. Service, Portland Me.....	65 H.P.	250 hr.		$2300
Inter City Airlines, E. Boston, Mass.....		225 hr.	160 hr.	1900
J. F. Whickir, Mun. A t., Ft. Wayne, Ind....	Cont.	35 hr.		1850
Mountain States A n, Denver, Colo....	Cont. 65	305 hr.	47 hr.	1695
J.A. Atherton Co., 24 niv., St. Paul, Minn.	Cont. 50	375 hr.	365 hr.	1600
Mountain States Aviation, Denver, Colo...	Cont. 65	700 hr.	280 hr.	1595
Cincinnati Aircraft Service, Cincinnati, O...	Lyc.	160 hr.		1500
Florida Aero & Supply, Orlando, Fla.....	Cont. 65	373 hr.	60 hr.	1450
G & R Air Services, Alexandria, Va.....	Cont. 65	275 hr.		1445
G & R Air Services, Alexandria, Va.....	Cont.65(dual)	259 hr.	5 hr.	1400
Edward's Flying Service, Flushing, N. Y....	Aeronca	200 hr.		1400
Tred Avon Flyg. Service, Easton, Md.....	Cont. 65	710 hr.	221 hr.	1400
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa.	Cont.	200 hr.	top	1395
Cincinnati Aircraft Service, Cincinnati, O..	Lyc.	455 hr.		1350
Edward's Flying Service, Flushing, N. Y....	Cont. 50			1295
Baker-Eberle Aviation Corp., Detroit, Mich.	Cont. 65	725 hr.		1275
Frontier Flyg. Serv., International Falls, Minn.	LeBlond 90	258 hr.	17 hr.	1275
Consol. School Aviation, E. St. Louis, Ill.....	Cont. 50	270 hr.		1275
Hass-Hillyard Flyg. Service, Evansville, Ind.	Lyc. 65	350 hr.		1250
Mountain States Aviation, 3800 Dahlia St., Omaha.....	Lyc.	654 hr.	Jan. '40	1250
Red Bank Arpt., Inc., Red Bank, N. J.....	Lyc. 50	195 hr.		1200
Warsaw Air Serv., 422 S. Union St., Warsaw, Ind.....	Cont. 50	275 hr.		1175
Baker-Eberle Aviation Corp., Detroit, Mich.	Cont. 50	400 hr.		1150
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa..	Lyc.	250 hr.		1150
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa..	Lyc.	250 hr.		1150
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa..	Lyc.	250 hr.		1150
Northern Air Serv., Grand Rapids, Mich...	Cont. 65	950 hr.	yes	1150
J. F. Whickir, Mun. Arpt., Ft. Wayne, Ind..	Cont. 65	587 hr.	15 hr.	1150
Baker-Eberle Aviation Corp., Detroit, Mich.	Frank. 50	915 hr.	Feb. '40	1100
Southeast Kansas Aircraft Serv., Chanute, Kans.....	Frank. 50		25 hr.	1100
Allied Aircraft Sales, Davenport, Iowa....	Lyc. 55	746 hr.	327 hr.	1100
Hass-Hillyard Flyg. Serv., Evansville, Ind..	Cont. 50	1100 hr.	1000 hr.	1100
J. A. Atherton Co., 2478 Univ., St. Paul, Minn.	Lyc. 50	350 hr.		1075
Aero-Ways, Inc., Cleveland.....	Cont. 50	127 hr.		1050
Aero-Ways, Inc., Cleveland.....	Cont. 50	203 hr.		1050
Queen City Flyg. Serv., Cincinnati, Ohio ..	Cont. 50	663 eng. 570 ship.	80 hr.	1050
H. G. Mayes, Mayes Field, Huntington, W. Va.....	Cont. 50	788 hr.	38 hr.	1050
Huron Flyg. Serv., Inc., Huron, So. Dakota.	Cont. 50	425 hr.	May '40	1050
Cincinnati Aircraft Service, Cincinnati, O...	Frank.	563 hr.		1025
United Aero Corp., San Antonio, Texas...	Frank. 50	700 hr.	200 hr.	1025
Red Bank Arpt., Inc., Red Bank, N. J.....	LeBlond 70	690 hr.	10 hr.	1000
Virginia Air Serv., Gordonsville, Va.....	Lyc. 50	600 hr.	May '40	1000
Chas. Roberts, Mun. Arpt., Dothan, Ala....	Cont. 50	375 hr.		1000
O. E. Dickerhoof, Mun. Arpt., Chanute, Kan.	Frank.	457 hr.	400 hr.	1000
Edward's Flying Service, Flushing, N. Y....	Cont. 50			995
H. G. Mayes, Arpt., Huntington, W. Va....	Cont. 50	690 hr.		995
Portland Flyg. Service, Portland, Me.....		200 hr. eng.		995
Hass-Hillyard Flyg. Serv., Evansville, Ind..	Cont. 50	800 hr.	700 hr.	900
Calif. Air Corp., Van Nuys, Calif.....	40 H. P.	742 hr.	yes	875
Inter-City Airlines, E. Boston, Mass.....		750 hr.	230 hr.	800
Florida Aero & Supply, Orlando, Fla.....	Aeronca 40	82 hr.		795
Inter-City Airlines, E. Boston, Mass.....	Cont. 40	782 hr.	238 hr.	795
Ryan Air Service, Decorah, Iowa.....	Aeronca 45	318 hr.		795
A. R. Smith, 113 E. Commerce, Aberdeen, Miss.....	E113C	800 hr.	Apr. '40	775
H. G. Mayes, Arpt., Huntington, W. Va...	E113C	462 hr.	Apr. '40	750
A. R. Smith, 113 E. Commerce, Aberdeen, Miss.....	E113C	875 hr.	Nov. '39	725
United Aero Corp., San Antonio, Texas...	Aeronca 40	295 hr.	5 hr.	$ 725
O. L. Hostetter, Thomasville, Pa.....	Aeronca	650 hr.	none	695
Mississippi Airways, Inc., Jackson, Miss....	Aeronca	406 hr.	Nov. '39	675
Hylan Flyg. Serv., Arpt., Rochester, N. Y....	Aeronca	300 hr.	300 hr.	650
Jenkins Air Serv., Rochester, N. Y.....	Aeronca 40	400 hr.		650
Al Leeward Aircraft Sales, New Kensington, Pa.....	E113C		100 hr.	565
Hobley-Maynard Air Serv., New Orleans, La.....	E113C		recently	550
Morley Airplane Co., Madison, Wisc.....	Aeronca	250 hr. eng.	needs none	550
Red Bank Airport, Inc., Red Bank, N. J....	Aeronca 36	800 hr.		550
Aviation Service, Inc., P.O. Box 308, Newport News, Va.....	E113C	500 hr.	80 hr. eng.	525
Jersey Flyg. Service, Oakland, N. J.	Aeronca 37	450 hr.	50 hr.	500
ARGO				
Red Bank Arpt., Inc., Red Bank, N. J.....	115 Hess	420 hr.	10 hr.	1000
ARISTOCRAT				
Red Bank Arpt., Inc., Red Bank, N. J.....	Warner 125	350 hr.	35 hr.	750
Red Bank Arpt., Inc., Red Bank, N. J.....	Warner Scarab	425 hr.	35 hr.	750
BEECH				
Arents Air Serv., Armonk, N. Y.....	Jacobs 330	400 hr.	165 hr.	7750
Inter-City Flyg. Serv., Ft. Wayne, Ind.....	Jacobs 285	385 hr.		6885
A. V. Ming, Red Bank Arpt., Red Bank, N. J.	Cont. 210	869 hr.	350 hr.	5500
E. W. Wiggins Airways, Inc., Airport, Norwood, Mass.....	Jacobs 285	580 hr.	200 hr.	5500
Hass-Hillyard Flyg. Serv., Evansville, Ind...	Wright 285	680 hr.	30 hr.	4500
Colorado Aviation, Denver, Colo.....	Jacobs 285	746 hr.	540 hr.	4500
Utah Pacific Airways, Inc., Ogden, Utah...	Jacobs	816 hr.	235 hr.	2500
BIRD				
Safair, Inc., Mineola, L. I.....	Kinner	215 hr.	yes	1400
L. A. Musgrove, Morgantown, W. Va.....	Kinner 125	650 hr.	July '39	1300
H. G. Mayes, Mayes Field, Huntington, W. Va.....	Kinner 125	600 hr.	75 hr.	1250
Safair, Inc., Mineola, L. I.....	Wright J65	500 hr.	190 hr.	1075
Jersey Flyg. Serv., Oakland, N. J.....	Kinner K5	850 hr.	yes	900
Leech Aircraft, Inc., Roosevelt Fld., N. Y...	Kinner		45 hr.	900
Florida Aero & Supply, Orlando, Fla.....	Kinner K5	1500 hr.	50 hr.	895
Hood Aircraft Sales, Northampton, Mass..	Kinner		just topped	845
Roy G. Lyon, RD No. 1, Warren, Ohio....	Kinner K5	800 hr.	yes	775
BUHL				
Barr Aviation Corp., Detroit, Mich.....	Wright 330	225 hr.	5 hr.	1000
CESSNA				
Jones Flyg. Serv., Columbus, Ohio.....	Warner 125	1300 hr.	July '39	925
COMMANDAIRE				
Rocky Mount Flyg. Ser., Rocky Mount, N. C.	Challenger	700 hr.	300 hr.	700
John K. Hinson, Rutherford Field, Baltimore, Md.....	Warner	1000 hr.	none	595
C-FLEDGLING				
Safair, Inc., Mineola, N. Y.....	Challenger	1072 hr.	yes	800

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
Safair, Inc., Mineola, N. Y.	Challenger	2500 hr.		$ 600
Miller Flying Serv. No. Benton, Ohio	Curtiss 185	600 hr.		550
PIPER CUB				
McBoyle Cub Sales, Spring Green, Wisc.	Cont. 65	50 hr.		1900
Aviation Service, Inc., Newport News, Va.	Cont.	70 hr.	none	1875
McBoyle Cub Sales, Spring Green, Wisc.	Cont. 65			1800
Wallace Aircraft Company, Clarcona, Fla.	Cont. 65	60 hr.	new ship	1800
Wallace Aircraft Company, Clarcona, Fla.	Cont. 65	60 hr.	new ship	1800
Wallace Aircraft Company, Clarcona, Fla.	Cont. 75	100 hr.	new ship	1798
Safair, Inc., Roosevelt Field, N. Y.	Cont. 65	115 hr.		1725
Lynchburg Air Transport and Sales, Lynchburg, Va.	Cont.	150 hr.	50 hr.	1700
Bethany Air Serv., Inc., Bethany Conn.	Cont	78 hr.		1650
Inter-City Airlines, E. Boston, Mass.		225 hr.	none	1650
Clovis Flyg. Service, Clovis, N.M.	Cont. 65	100 hr.	none	1575
McBoyle Cub Sales, Spring Green, Wisc.	Cont. 65			1575
McBoyle Cub Sales, Spring Green, Wisc.	Cont. 65			1550
Southern Air Serv., Memphis, Tenn.	Cont. 65	100 hr.	new	1550
Bethany Air Serv., Inc., Bethany, Conn.	Cont.	201 hr.		1500
Inter-City Airlines, E. Boston, Mass	Cont. 65	246 hr.	246 hr.	1500
Seidner Flyg. Serv., Youngstown, Ohio	Cont. 65	96 hr.		1495
Hylan Flyg. Serv., Rochester Arpt., Rochester, N. Y.	Cont. 65	450 hr.	25 hr.	1450
Piedmont Aviation Corp., Winston-Salem, N.C.	Cont. 65	275 hr.	52 hr.	1450
Virginia Cub Dist., Box 211, Farmville, Va.	Cont. 50	200 hr.	none	1450
E. W. Wiggins Airways, Inc., Norwood, Mass.	Cont. 65	139 hr.		1395
Northway Flyg. Serv., Columbus, Ohio	Frank. 60	300 hr.		1350
L. A. Musgrove, Morgantown, W. Va.	Cont. 65	310 hr.	Mar.'40	1350
L. A. Musgrove, Morgantown, W. Va.	Cont. 65	250 hr.	none	1300
McBoyle Cub Sales, Spring Green, Wisc.	Frank. 60			1300
Gillis Flyg. Serv., Great Falls, Mont.	Cont. 50	75 hr.	none	1300
Carolina Aircraft Sales, Charlotte, N. C.	Cont. 65	310 hr.	40 hr.	1298
Piedmont Aviation Corp., Winston-Salem, N. C.	Cont. 50	178 hr.	65 hr.	1275
Port Columbus Flyg. School, Columbus, O.	Cont. 65	95 hr.		1250
J. L. Schroeder, Inc., Rt. 3, Box 117, Houston, Texas	Frank. 60	235 hr.	none	1250
Barr Aviation Corp., Detroit, Mich.	Cont. 65	230 hr.	none	1200
Gillis Flyg. Serv., Great Falls, Mont.	Frank. 50	180 hr.	none	1200
McBoyle Cub Sales, Spring Green, Wisc.	Frank.	77 hr.		1200
McBoyle Cub Sales, Spring Green, Wisc.	Frank. 50			1200
Seidner Flyg. Serv., Youngstown, Ohio	Frank. 60	35 hr.		1200
Southern Airways, Inc., Danville, Va.	Lyc. 55	105 hr.	none	1200
Palm Beach Aero Corp., W. Palm Beach, Fla.	Cont.	92 hr.	new	1195
Barr Aviation Corp, Detroit, Mich.	Cont. 50	854 hr.	35 hr. eng.	1175
McBoyle Cub Sales, Spring Green, Wisc.	Frank.	98 hr.		1175
Geo. C. Haven, Schenectady, N. Y.	Frank. 50	25 hr.	none	1150
Aaron Flying Service, Louisville, Ky.	Frank. 50	85 hr.		1125
E. E. Eno, Eno Airport, Ft. Dodge, Iowa	Lyc. 50	425 hr.	never	1125
Ellis Eno Flying Service, Ft. Dodge, Iowa	Lyc. 50			1100
Art. Whitaker, Portland Arpt., Portland, Ore.	Frank. 50	300 hr.	300 hr.	1100
B. F. Hines, Mex.-Tex. Arpt., Hobbs, N.M.	Frank.	350 hr.	50 hr.	1075
Northway Flyg. Serv., Columbus, Ohio	Frank. 50	275 hr.		1075
Jersey Flyg. Serv., Oakland, N. J.	Frank. 60	40 hr.	none	1050
Hudson Valley Air Co., Middletown, N. Y.	Cont. 50	230 hr.	none	1050
L. A. Musgrove, Morgantown, W. Va.	Frank. 50	180 hr.	none	1050
W. Va. Air Service, Inc., Clarksburg, W. Va.	Frank 50	80 hr.	none	1050
W. Va. Air Service, Inc., Clarksburg, W.Va.	Lyc. 50	210 hr.	none	1050
Art. Whitaker, Portland Arpt., Portland, Ore.	Frank. 50	600 hr.	600 hr.	1050
Ray Wilson Inc., Park Hill, Arpt., Denver, Colo.	Frank.	522 hr.	none	1030
Ray Wilson, Inc., Park Hill Arpt., Denver, Colo.	Frank.	523 hr.	none	1030
John K. Hinson, Rutherford Field, Baltimore, Md.	Frank. 50	150 hr.	50 hr.	1025
John K. Hinson, Rutherford Field, Baltimore, Md.	Frank. 50	344 hr.	69 hr.	1000
Northway Flyg. Serv., Columbus, Ohio	Frank. 50	475 hr.		1000
Page Airways, Inc., Rochester, N. Y.	Lyc. 50	450 hr.	none	1000
Utah Pacific Airways, Inc., Ogden, Utah	Lyc. 55	575 hr.	575 hr.	1000
G. L. Williams, Syracuse Arpt., Syracuse, N. Y.	Frank. 50	400 hr.		1000
Lexington Flyg. Serv., Inc., Lexington, Ky.	Frank.	180 hr.	none	995
H. G. Mayes, Huntington, W. Va.	Cont. 50	530 hr.		995
St. Louis Flyg. Serv., Lambert Field, St. Louis, Mo.	Frank. 50	172 hr.		995
Lexington Flyg. Serv., Inc., Lexington, Ky.	Lyc.	560 hr.	none	975
Consol. Sch. Avia., E. St. Louis, Ill.	Frank. 50	300 hr.		975
Piedmont Aviation Corp., Winston-Salem, N. C.	Cont. 50	482 hr.	161 hr.	975
St. Louis Flyg. Serv., Lambert Field, St. Louis, Mo.	Frank. 50	484 hr.		975
St. Louis Flyg. Serv., Lambert Field, St. Louis, Mo.	Frank. 50	528 hr.		975
Tenn. Aero Corp., Nashville, Tenn.	Frank. 50	250 hr.		970
Airways, Inc., Waterville, Me.	Frank. 50	240 hr.		950
Mississippi Airways, Inc., Jackson, Miss.	Cont. 50	615 hr.	May '40	950
J. F. Whickir, Mun. Arpt., Ft. Wayne, Ind.	Cont. 50	86 hr.		950
Frost Air Serv., West Haven, Conn.	Cont. 50	290 hr.	none	950
Aviation Service, Inc., Newport News, Va.	Lyc. 50	460 hr.	none	925

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
St. Louis Flyg. Serv., Lambert Field, St. Louis, Mo.	Frank. 50	193 hr.		$925
Ray Wilson, Inc., Park Hill Arpt., Denver, Colo.	Frank.	640 hr.	none	910
Bethany Air Serv., Inc., Bethany, Conn.	Lyc.	510 hr.	110 hr.	900
Southern Air Serv., Memphis, Tenn.	Lyc. 50	300 hr.	new	900
Clinton Co. Arpt., De Witt, Iowa	Frank.	525 hr.		900
Hawthorne Flyg. Serv., Arpt., Charleston, S. C.	Frank. 50			900
Toomey, Gatliff & Webb, Knoxville, Tenn.	Frank. 50	450 hr.	none	900
Utah Pacific Airways, Inc., Ogden, Utah	Cont. 50	500 hr.	25 hr.	900
Aaron Flying Service, Louisville, Ky.	Frank. 50	460 hr.	Jan. '40	895
Hood Aircraft Sales, LaFleur Arpt., Northampton, Mass.	Cont. 50	375 hr.		895
Midwest Aviation Sales, LaGrange, Ill.	Frank. 50	406 hr.	60 hr.	850
Jersey Flyg. Serv., Oakland, N. J.	Frank. 50	265 hr.	5 hr.	850
Palm Beach Aero Corp., W. Palm Beach, Fla.	Cont.	92 hr.	new	850
W. Va. Air Service, Inc., Clarksburg, W. Va.	Cont. A-40	119 hr.	none	845
Rocky Mount Flyg. Serv., Rocky Mount, N.C.	Cont. A-40-4	215 hr.	215 hr.	800
Toomey, Gatliff & Webb, Knoxville, Tenn.	Frank. 50	800 hr.	Feb. '40	800
Jenkins Air Serv., Rochester, N. Y.	Cont. 40	700 ship. 450 eng.	25 hr.	775
Clinton Co. Arpt., De Witt, Iowa	Cont. A-40	550 hr.		750
Hudson Valley Air. Co., Middletown, N. Y.	Cont. 65	28 hr.	none	750
E. E. Eno, Eno Airport, Ft. Dodge, Iowa	Cont. 40	600 hr.	100 hr.	745
Northway Flyg. Serv., Columbus, Ohio	Cont. 40	275 hr.		725
Hudson Valley Air. Co., Middletown, N. Y.	Cont. 40	300 hr.	20 hr.	700
Hawthorne Flyg. Serv., Arpt., Charleston, S. C.	Cont. A-40	May '40		675
Hawthorne Flyg. Serv., Arpt., Charleston, S. C.	Cont. A-40	600 hr.	just ovr.	675
Allied Aircraft, Davenport, Iowa	Cont. 40	385 hr.	100 hr.	650
Hume & Smyer, Arkansas City, Kans.	Cont. 40	380 hr.	150 hr.	650
Carolina Aircraft Sales, Charlotte, N. C.	Cont. 40	491 hr.	60 hr.	650
Edward's Flying Service, Flushing, N. Y.	Cont. A-40			650
Harrisburg Air Serv., Harrisburg, Pa.	Cont.	200 hr.	8 hr.	650
W. Va. Air Service, Inc., Clarksburg, W. Va.	Cont. A-40	490 hr.	35 hr.	645
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa.	Cont. 40	200 hr.	topped	625
Frost Air Serv., West Haven, Conn.	Cont. 40	355 hr.	recently	625
P. A. Meinke, Willoughby, Ohio	Cont.	475 hr.		625
Warsaw Air Serv., 422 S. Union, Warsaw, Ind.	Cont. 40	240 hr.		625
Fox Valley Flyg. Serv., Aurora, Ill.	Cont.	850 hr.	150 hr.	600
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-40	500 hr.		600
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-40	500 hr.	none	600
J. L. Schroeder, Inc., Rt. 3, Box 117, Houston, Tex.	Cont. 40	560 hr.	none	575
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-40	500 hr.		575
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-40	500 hr.	none	575
P. A. Meinke, Willoughby, Ohio	Cont.	75 hr.		550
Virginia Air Serv., Gordonsville, Va.	Cont. A-40-4	650 hr.	500 hr.	550
Chas. Roberts, Mun. Arpt., Dothan, Ala.	Cont. 40	400 hr.	Mar. '40	550
Rocky Mount Flyg. Serv., Rocky Mount, N.C.	Cont. A-40-4	650 hr.	40 hr.	550
Virginia Cub Dist., Box 211, Farmville, Va.	Cont. 40	400 hr.	none	525
Springfield Flyg. Serv., Springfield, Mo.	Cont. 40	800 hr.		500
Hawthorne Flyg. Serv., Arpt., Charleston, S.C.	Cont. A-40	600 hr.		500
Virginia Stinson Dist., Staunton, Va.	Cont.	370 hr.	20 hr.	500
CURTISS-ROBIN				
Huron Flyg. Serv., Huron, S. Dakota	Wright J65	700 hr.	Apr. '39	650
United Aero Corp., San Antonio, Texas	Challenger	650 hr.	300 hr.	650
DART				
Brayton Flyg. Serv., Lambert Arpt., Robertson, Mo.	Ken-Royce	250 hr.	200 hr.	2975
Port Columbus Flyg. School, Columbus, Ohio	Lambert	915 hr.		1950
EAGLEROCK				
Thompson Flyg. Serv., Salt Lake City, Utah.	Wright J5	1049 hr.	149 hr.	1000
Art. Whitaker, Portland Arpt., Portland, Ore.	Wright	1050 hr.	250 hr.	650
J. O. Dockery, Stuttgart, Ark.	Hisso 180	800 hr.	70 hr.	550
FAIRCHILD				
Carolina Aircraft Sales, Charlotte, N. C.	Warner 145	102 hr.	new ship	5750
Arents Air Serv., Armonk, N. Y.	Ranger	409 hr.	none	5200
Lynchburg Air Transport & Sales, Lynchburg, Va.	Warner	450 hr.	100 hr.	3500
Colorado Aviation, Denver, Colo.	Warner 145	470 hr.	50 hr.	3150
Leech Aircraft Inc., Roosevelt Field, N. Y.	Warner 125		-	2600
Calif. Aircraft Corp., Van Nuys, Calif.	Warner 145	400 hr.	none	2250
Ellis Eno Flying Service, Ft. Dodge, Iowa	Warner 145		recently	2175
Schneider Aero Serv., Fresno, Calif.	Warner 145	954 hr.	206 hr.	2150
Calif. Aircraft Corp., Van Nuys, Calif.	Wright 330	1150 hr.	160 hr.	1375
Harrisburg Air Serv., Harrisburg, Pa.	Wright	800 hr.	200 hr.	1100
Inter-City Airlines, E. Boston, Mass.	Cirrus 90	1080 hr.	95 hr.	1000

Popular Aviation USED PLANE LISTING OF AU

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
FLAMINGO				
Des Moines Flyg. Serv., Inc., Des Moines, Ia.	Wasp 450	3000 hr.	135 hr.	$1600
FLEET				
Calif. Air. Corp., Van Nuys, Calif.	Kinner K-5	3643 hr.	none	1325
Safair, Inc., Roosevelt Field, N. Y.	Kinner	597 hr.		850
Arents Air Serv., Armonk, N. Y.	Kinner K-5	1673 hr.	324 hr.	825
FOKKER				
Al Leeward Aircraft Sales, New Kensington, Pa.	Wright 330			795
FRANKLIN				
Miller Flying Serv., No. Benton, Ohio.	Lambert 90	450 hr.		695
GREAT LAKES				
Racine Flyg. Serv., Inc., Racine, Wisc.	Cirrus	287 hr.	27 hr.	950
Racine Flyg. Serv., Inc., Racine, Wisc.	Cirrus	362 hr.	125 hr.	800
United Aero Corp., San Antonio, Tex.	Cirrus	700 hr.	15 hr.	775
P. A. Meinke, Willoughby, Ohio.	Cirrus	900 hr.		675
KELLETT AUTOGIRO				
Red Bank Arpt., Red Bank, N. J.	Cont. 210	400 hr.		1700
KINNER SPORTWING				
Schneider Aero. Serv., Fresno, Calif.	B-5 125	1335 hr.	506 hr.	1350
Louisville Flyg. Serv., Inc., Louisville, Ky.	Kinner K-5	460 hr.		945
Safair, Inc., Roosevelt Field, N. Y.	Kinner	2355 hr.	20 hr.	895
LINCOLN				
Fox Valley Flyg. Serv., Aurora, Ill.	Kinner	1468 hr.	150 hr.	500
H. B. Chapman, N. O. Arpt., New Orleans, La.	Kinner 100	985 ship. 750 eng.	'39	500
LOCKHEED				
Des Moines Flyg. Serv., Inc., Des Moines, Ia.	Wasp 450	1500 hr.	75 hr.	3500
LUSCOMBE				
Iowa Airplane Co., Mun. Arpt., Des Moines, Iowa.	Cont. 65	125 hr.	125 hr.	1875
Massey & Ransom Flyg. Serv., Denver, Colo.	Cont. 65	335 hr.		1875
Jersey Flyg. Serv., Oakland, N. J.	Cont. 65	91 hr.		1850
Iowa Airplane Co., Mun. Arpt., Des Moines, Iowa.	Cont. 65	350 hr.	350 hr.	1750
Page Airways, Inc., Rochester, N. Y.	Cont. 65	200 hr.	none	1750
Massey & Ransom Flyg. Serv., Denver, Colo.	Cont. 65	350 hr.	60 hr.	1725
Iowa Airplane Co., Mun. Arpt., Des Moines, Iowa.	Cont. 65	400 hr.	400 hr.	1700
Page Airways, Inc., Rochester, N. Y.	Cont. 65	400 hr.	10 hr.	1700
W. F. Luke, Schenectady, N. Y.	Cont. 65	100 hr.		1657
Luscombe Airplane Corp., 247 Park, N.Y.C.	Cont. 50	new	new	1650
Massey & Ransom Flyg. Serv., Denver, Colo.	Cont. 65	490 hr.		1650
Consol. Sch. Avia., E. St. Louis, Ill.	Cont. 65	180 hr.		1650
Midwest Aviation Sales, La Grange, Ill.	Cont. 65	385 hr.	5 hr.	1550
Arents Air Serv., Armonk, N. Y.	Cont. 65	325 hr.	60 hr.	1450
Northern Air Serv., Grand Rapids, Mich.	Cont. 65	643 hr.	top	1375
Queen City Flyg. Serv., Cincinnati, Ohio.	Cont. 50	469 eng. 402 ship.		1250
Midwest Aviation Sales, La Grange, Ill.	Cont. 50	550 hr.	50 hr.	1250
MONOCOACH				
Dewey Eldred Flyg. Serv., Willoughby, O.	Wright	250 hr.		700
MONOCOUPE				
Cape Aircraft, Inc., Hatchville, Mass.	Lambert 90	340 hr.	340 hr.	1550
Sky Harbor, Inc., Indianapolis, Ind.	Lambert	275 hr.	July '39	1200
Huron Flyg. Serv., Huron, So. Dakota.	Warner 125	535 hr.	Sept. '39	945
Ellis Eno Flying Service, Ft. Dodge, Iowa.	Lambert 90		recently	800
MOTH				
Luscombe Airplane Corp., 247 Park, N.Y.C.	Gypsy Major	none	new	4000
NEW STANDARD				
Oneal Aircraft, Vincennes, Ind.	J-5	700 hr.	20 hr.	1550
Safair, Inc., Mineola, N. Y.	Kinner	1200 hr.	100 hr.	595
PARKS				
Hylan Flyg. Serv., Rochester, N. Y.	Wright 175	514 hr.	150 hr.	1250

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
PORTERFIELD				
Inter-City Airlines, E. Boston, Mass.	LeBlond 70	330 hr.	30 hr.	$ 950
Bethany Air Serv., Inc., Amity Rd., Bethany, Conn.	LeBlond	178 hr.		900
Livingston Airways, Waterloo, Ia.	LeBlond 70	450 hr.	100 hr.	895
Geo. C. Haven, Schenectady, N. Y.	LeBlond 70	450 hr.	100 hr.	895
W. F. Luke, Schenectady, N. Y.	LeBlond 70	not given	Apr. '40	800
Dawson Air Serv., Salina, Kans.	LeBlond	700 hr.	just topped	695
Hood Aircraft Sales, Northampton, Mass.	Cont. 40	68 hr.	new ship	595
Airways, Inc., Waterville, Me.				
Currey Flying Serv., W. Losey, Galesburg, Ill.	Cont. A-40	500 hr.	40 hr.	550
REARWIN				
A. E. Padage, Tri-City Arpt., Wisc. Rapids, Wisc.	LeBlond 70	177 hr.	none	1575
Midwest Aviation Sales, La Grange, Ill.	LeBlond 90	338 hr.	50 hr.	1250
Four Lakes Aviation, Madison, Wisc.	LeBlond	270 hr.		1150
Airways, Inc., Waterville, Me.	LeBlond 85	280 hr.	new ship	1000
Neil E. McCray, Mun. Arpt., Jamestown, N.Y.	LeBlond	750 hr.	200 hr.	995
P. A. Meinke, Willoughby, Ohio.	LeBlond	900 hr.		975
Cape Aircraft, Inc., Hatchville, Mass.	LeBlond 85	482 hr.	482 hr.	950
Racine Flyg. Serv., Inc., Racine, Wisc.	LeBlond 70	550 hr.	3 hr.	925
A. E. Padage, Tri-City Arpt., Wisc. Rapids, Wisc.	LeBlond 70	734 hr.	37 hr.	850
ROBIN				
Utah Pacific Airways, Inc., Ogden, Utah.	J-6-5	1075 hr.	25 hr. eng.	1100
Portland Flyg. Serv., Portland, Me.	J-6-5	800 hr.	45 hr.	995
Raymond Aero Service Co., Macon, Ga.	Wright	800 hr.	Nov. '39	950
Thompson Flyg. Serv., Salt Lake City, Utah	Challenger	825 hr.	no time	850
Clovis Flyg. Serv., Clovis, N. M.	J-6-5	600 hr.	Feb. top	850
Safair, Inc., Roosevelt Field, N. Y.	Challenger			725
Fox Valley Flyg. Serv., Aurora, Ill.	Challenger	870 hr.	35 hr.	575
RYAN				
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa.	Menasco	244 hr.		2850
Lynchburg Air Transport & Sales, Lynchburg, Va.	Menasco	550 hr.	115 hr.	2450
J. L. Schroeder, Inc., Rt. 3, Houston, Texas.	J-5 Wright	615 hr.	21 hr.	875
J. O. Dockery, Stuttgart, Ark.	J-5	600 hr.	100 hr.	850
Oneal Aircraft, Vincennes, Ind.	J-5	950 hr.	200 hr.	850
SIKORSKY				
Gilpin Airlines, Tucson, Arizona.	Wasp 375		300 hr.	5500
Luscombe Airplane Corp., 247 Park, N.Y.C.	Wasp	850 hr.	25 hr.	5060
SPARTAN BIPLANE				
Wichita Falls Air Trans., Wichita Falls, Tex.	Wright 240	330 hr.	110 hr.	900
Spartan Scho. Aero., Tulsa, Okla.	Wright 540			850
Spartan Scho. Aero., Tulsa, Okla.	Walter 120	new	new	500
STANDARD				
Virginia Stinson Dist., Staunton, Va.	Kinner B5		60 hr. back	975
STINSON				
Brayton Flyg. Serv., Robertson, Mo.	Lyc.	578 hr.	450 hr.	7800
Sioux Skyways, Sioux Falls, S. Dak.	Lyc. 260	235 hr.	235 hr.	7200
Air Service, Inc. Denver, Colo.	Wright	386 hr.	40 hr. back	5900
Spartan Scho. Aero., Tulsa, Okla.	Lyc. 260		100 hr.	5500
E. W. Wiggins Airways, Inc., Norwood, Mass.	Lyc. 245	1085 hr.	15 hr.	3900
Portland Flyg. Serv., Portland Me.	Lyc. 260	750 hr.	'39	3500
J. A. Atherton Co., St. Paul, Minn.	Cont. 80	40 hr.		3295
Chicago Aviation Corp., Glenview, Ill.	Lyc.	100 hr.	100 hr. since	2995
Leech Aircraft Inc., Roosevelt Field, N. Y.	Cont. 75	24 hr.		2700
Calif. Aircraft Corp., Van Nuys, Calif.	Cont. 75	100 hr.		2650
E. E. Eno, Fort Dodge, Iowa.	Lyc 245	450 hr.	150 hr.	2650
Leech Aircraft Inc., Roosevelt Field, N. Y.	Cont. 75	88 hr.		2600
Neil E. McCray, Mun. Arpt., Jamestown, N. Y.	Cont.	16 hr.	16 hr.	2600
E. Turner Aero. Corp., Indianapolis, Ind.	Cont. 75	165 hr.	none	2600
Geo. C. Haven, Schenectady, N. Y.	Cont. 75	90 hr.	none	2550
Sioux Skyways, Sioux Falls, S. Dak.	Cont. 75	225 hr.	25 hr.	2500
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-75	150 hr.		2500
Southern Airways Sales Co., Birmingham, Ala.	Cont. A-75	150 hr.	none	2500
Virginia Stinson Dist., Staunton, Va.	Cont. 75	80 hr.		2400
P. J. Sones Co., Haines City, Fla.	Cont.	175 hr.	none	2350
Jenkins Air Serv., Inc., Rochester, N. Y.	Cont. 75	170 hr.		2350
Baker-Eberle Aviation Corp., Detroit, Mich.	Cont. 75	10 hr.	Sept. '30	2300
G. L. Williams, Syracuse Arpt., Syracuse, N. Y.	Cont. 75	200 hr.		2300
Chicago Aviation Corp., Glenview, Ill.		290 hr.		2295
Dockery Air Serv., Box 817, Stuttgart, Ark.	SR5	650 hr.	Jan. '39	2250
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa.	Cont.	246 hr.		2200
Inter-City Airlines, E. Boston, Mass.	Cont. 75	315 hr.	none	2200

AUTHORIZED AIRCRAFT DEALERS

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
Morey Airplane Co., Madison, Wisc.	Lyc.	unknown	needs none	$2200
Hume & Snyder, Arkansas City, Kans.	Lyc. 245	510 hr.	180 hr.	2170
Inter-City Airlines, E. Boston, Mass.	Cont. 75	430 hr.	just majored	2150
Palm Beach Aero Corp., W. Palm Beach Fla.	Cont.	225 hr.	new	2150
Raymond Aero Service Co., Airport, Macon, Ga.	Wasp Jr.	950 hr.	Mar. '38	2000
Ellis Eno Flying Service, Ft. Dodge, Iowa	Lyc. 245	Oct. '40	recently	1950
Morey Airplane Co., Madison, Wisc.	Lyc.	800 hr.	350 hr.	1900
Miller Flying Service, No. Benton, Ohio.	Lyc. 225	560 hr.		1850
Inter-City Flyg. Serv., Ft. Wayne, Ind.	Lyc. 215	700 hr.	recently	1800
Page Airways, Inc., Rochester, N. Y.	Lyc.	1500 hr.	250 hr.	1750
Moberly Flying Service, Moberly, Mo.	Lyc.	1220 hr.	30 hr.	1650
Brayton Flyg. Serv., Robertson, Mo.	Lyc.	738 hr.	126 hr.	1450
Gillis Flyg. Serv., Great Falls, Mont.	Lyc. 215	800 hr.	240 hr.	1300
Harrisburg Air Serv., Harrisburg, Pa.	Lyc.	700 hr.	175 hr.	1300
J. L. Schroeder, Inc., Rt. 3, Houston, Texas	Lyc.	432 hr.	150 hr.	1250
Canton Aviation Co., Canton, Ohio.	Lyc. 215		yes	1200
Huron Flyg. Serv., Huron, So. Dakota	Lyc. 215	1056 hr.	May '40	1195
Niederhauser Airways, Marshalltown, Ia.	Lyc.	1350 hr.	40 hr.	1100
G & R Air Services, Alexandria, Va.	Lyc. 215	1250 hr.	Aug. '39	1095
G & R Air Services, Alexandria, Va.	Lyc. 215	1050 hr.	275 hr.	1050
Carolina Aircraft Sales, Charlotte, N. C.	Lyc.	832 hr.	9 hr.	1000
Neil R. McCray, Mun. Arpt., Jamestown,N.Y.	Lyc. 215	1100 hr.	300 hr.	995
Barr Aviation Corp., Detroit, Mich.	Lyc. 215	890 hr.	5 hr. eng.	950
Maheux's Arpt., Inc., Auburn, Me.	Lyc. 215		250 hr.	900
Virginia Stinson Dist., Staunton, Va.	Lyc.			700
TAYLORCRAFT				
Colorado Aviation, Denver, Colo.	Cont. 65	120 hr.	demonstrator	1835
Inter-City Flyg. Serv., Ft. Wayne, Ind.	Cont. 65	120 hr.	none	1800
Aircraft Unlimited, Mineola, N. Y.	Lyc. 65	22 hr.		1750
Leavens Bros., Barker Arpt., Toronto, Can.	Cont. A-50-5	614 hr.		1750
Niederhauser Airways, Marshalltown, Ia.	Lyc. 65	150 hr.	new	1700
Leavens Bros. Barker Arpt., Toronto, Can.	Cont. A-50-3	1095 hr.		1600
Niederhauser Airways, Marshalltown, Ia.	Lyc. 65	50 hr.	new	1600
Rochester Aero Corp., Rochester, N. Y.	Lyc.	250 hr.		1500
Fox Valley Flyg. Serv., Aurora, Ill.	Lyc. 65	125 hr.		1500
Ed. Nibur, Madiera Arpt., Bernharts, Pa.	Cont. 65	385 hr.		1500
Aviation Country Club, Cedar Rapids, Ia.	Frank. 50	86 hr.	none	1500
Merrill Hale, Hillsgrove, R. I.	Cont. 65	490 hr.		1495
Fox Valley Flyg. Serv., Aurora, Ill.	Lyc. 65	106 hr.		1475
Ed. Nibur, Madiera Arpt., Bernharts, Pa.	Lyc. 55	120 hr.		1450
Gilpin Airlines, Tucson, Arizona	Cont. 50	350 hr.	none	1450
L. A. Musgrove, Morgantown, W. Va.	Lyc.	60 hr.	none	1400
L. A. Musgrove, Morgantown, W. Va.	Lyc. 50	72 hr.	new	1375
Reifenberg Aviation, St. Johns, Pa.	Lyc. 55	138 hr.		1325
Northern Okla. Flyg. Serv., Arpt., Blackwell, Okla.	Frank.	80 hr.	like new	1300
Aviation Country Club, Cedar Rapids, Ia.	Cont. 50	247 hr.	none	1300
Ryan Air Service, Decorah, Iowa	Lyc. 50	295 hr.		1250
K. Johannesson Flyg. Serv. Arpt., Winnipeg, Can.	Cont. A-403			1250
K. Johannesson Flyg. Serv. Arpt., Winnipeg, Can.	Cont. A-403	800 hr.		1250
Raymond Aero Serv. Co., Smart Arpt., Macon, Ga.	Lyc.	685 hr.	March '40	1250
Baltimore School of Aero. Curtiss-Wright Arpt., Baltimore, Md.	Lyc.	415 hr.		1200
Baltimore School of Aero. Curtiss-Wright Arpt., Baltimore, Md.	Lyc.	341 hr.		1200
Baltimore School of Aero. Curtiss-Wright Arpt., Baltimore, Md.	Lyc.	227 hr.		1200
R. Turner Aero. Corp., Indianapolis, Ind.	Frank. 50	247 hr.	top	1200
A. J. Moore, 324 State St., Baden, Pa.	Lyc. 55	435 hr.	40 hr.	1150
Youngstown Airways, Youngstown, Ohio.	Lyc. 50	175 hr.		1150
Schneider Aero Serv., Fresno, Calif.	Cont. 50	737 hr.	49 hr.	1150
Canton Aviation Co., Canton, Ohio.	Lyc. 50	291 hr.	yes	1150
Raymond Aero Serv. Co., Smart Arpt., Macon, Ga.	Cont.	550 hr.	Nov. '39	1150
Baltimore School of Aero. Curtiss-Wright Arpt., Baltimore, Md.	Frank.	693 hr.	183 hr.	1100
Leavens Bros. Barker Arpt., Toronto, Can.	Cont. A-40	1172 hr.		1100
Pt. Columbus Flyg. School, Columbus, Ohio.	Lyc.	692 hr.		1100
Rochester Aero Corp., Rochester, N. Y.	Lyc.	475 hr.	25 hr.	1100
Jesse Jones, Lancaster, Pa.	Lyc. 55	350 hr.	none	1100
Niederhauser Airways, Marshalltown, Ia.	Lyc. 55	300 hr.	yes	1100
Gilpin Airlines, Tucson, Arizona	Cont. 50	800 hr.	none	1100
Merrill Hale, Hillsgrove, R. I.	Frank. 50	268 hr.	35 hr.	1050
Pt. Columbus Flyg. School, Columbus, O.	Lyc.	867 hr.		1000
Brayton Flyg. Serv., Arpt., Robertson, Mo.	Cont. A-40-4		just ovr.	945
Roy G. Lyon, R.D. No. 1, Warren, Ohio.	Lyc. 50	500 hr.	yes	895
Dewey Eldred Flyg. Serv., Willoughby, O.	Cont. 40			850
Hood Aircraft Sales, Northampton, Mass.	Cont. 40	550 hr.	125 hr.	850
W. F. Luke, Schenectady, N. Y.	Frank. 50	350 hr.		825
Northern Okla. Flyg. Serv., Arpt., Blackwell, Okla.	Cont. A-40	1310 hr.	1260 hr.	800
Aviation Country Club, Cedar Rapids, Ia.	Cont. 40	635 hr.	Dec. '39	800
L. A. Musgrove, Morgantown, W. Va.	Cont. 40	320 hr.	May '39	795
Warsaw Air Serv., 422 S. Union, Warsaw, Ind.	Cont.	360 hr.		795
Sioux Skyways, Sioux Falls, S. Dak.	Cont. 40	600 hr.	65 hr.	785
R. Turner Aero. Corp., Indianapolis, Ind.	Cont. A-40	380 hr.	70 hr.	775
Dawson Air Serv., Salina, Kans.	Cont. 40	500 hr.	recently	750
Ryan Air Service, Decorah, Iowa	Cont. 40	326 hr.		750

DEALERS	ENGINE	TIME	OVERH'L'D	PRICE
A. R. Smith, 113 E. Commerce, Aberdeen, Miss.	Cont. A-40	800 hr.	Oct. '39	$ 725
Blvd. Arpt., Inc., Roosevelt Blvd., Phila., Pa.	Cont. 40	400 hr.	100 hr. ago	700
Currey Flyg. Serv., 781 W. Losey, Galesburg, Ill.	Cont. A-40	500 hr.	50 hr.	700
Dewey Eldred Flyg. Serv., Willoughby, O.	Cont. 40			700
Southern Airways Sales Co., Birmingham, Ala.	Cont.	500 hr.		700
Southern Airways Sales Co., Birmingham, Ala.	Cont.	500 hr.	none	700
Stinson Flyg. Corp., 1044 Airways, Glendale, Calif.	Cont. A-40	1300 hr.	161 hr.	700
Livingston Airways, Waterloo, Ia.	Cont. 40	825 hr.		700
Merrill Hale, Hillsgrove, R. I.	Cont. 40	1081 hr.	100 hr.	695
Palm Beach Aero Corp., W. Palm Beach, Fla.	Cont.	342 hr.	Dec. '39	695
Springfield Aviation, Springfield. Ill.	Cont. 40	287 ship. 167 eng.		675
J. F. Whickir, Mun. Arpt., Ft. Wayne, Ind.	Cont. 40	430 hr.	10 hr.	675
Sky Sport Associates, Inc., Sharonville, O.	Cont. A-40	975 hr.	192 hr.	650
Hobley-Maynard Air Serv., New Orleans, La.	Aero. 36	750 hr.	Jan. '40	550
TRAVELAIR				
Toomey, Gatliff & Webb, Knoxville, Tenn.	J69-330	300 hr.	May '38	2000
Stinson Flyg. Corp., 1044 Airways, Glendale, Calif.	330 H.P.	1039 hr.	5 hr.	2000
Calif. Aircraft Corp., Arpt., Van Nuys, Calif.	Wright	1082 hr.	20 hr.	1750
Art. Whitaker, Portland Arpt., Portland, Ore.	Wright	800 hr.	85 hr.	1650
Ray Wilson, Inc., Park Hill Arpt., Denver, Colo.	Wright J-5	608 hr.	81 hr.	1600
Jones Flyg. Serv., Columbus, Ohio.	Wright J-5	500 hr.	May '38	1250
Sky Harbors, Inc., Indianapolis, Ind.	Wright	600 hr.	80 hr.	1200
Chicago Aviation Corp., Glenview, Ill.	Wright	240 hr.		995
Northern Air Serv., Grand Rapids, Mich.	J-5 225	600 hr.	topped	995
Racine Flyg. Serv., Inc., Racine, Wisc.	Gypsy	172 hr.	none	900
Hudson Valley Air Co., Middletown, N. Y.	Kinner 100	800 hr.	3 hr.	750
Des Moines Flyg. Serv., Inc., Des Moines, Ia.	Warner 125	800 hr.	140 hr.	745
WACO				
Spartan Sch. Aero., Tulsa, Okla.	Wright 350		none	5500
Chicago School of Aero., Inc., Mt. Prospect, Ill.	Jacobs	790 hr.	150 hr.	3665
Sioux Skyways, Sioux Falls, S. Dak.	Jacobs 225	750 hr.	300 hr.	2985
Miss. Airways, Inc., Jackson, Miss.	Jacobs 225	295 hr.		2800
R. Turner Aero. Corp., Indianapolis, Ind.	Jacobs 225	unknown		2750
Neil McCray, Airport, Jamestown, N. Y.	Jacobs	375 hr.	150 hr.	2750
Cape Aircraft, Inc., Hatchville, Mass.	Jacobs 225	508 hr.	17 hr.	2500
Air Service, Inc., Denver, Colo.	Jacobs 225	900 hr.	175 hr. back	2400
Southern Airways, Inc., Danville, Va.	Jacobs 225	872 hr.	436 hr.	2150
B. F. Hines, Mex.-Tex. Arpt., Hobbs, N. M.	Jacobs 210	400 hr.		2100
Phillips Flyg. Serv., Mt. Pleasant, Mich.	Cont. 210	470 hr.		2000
Beebe Air Service, Hastings, Neb.	Cont.	450 hr.	Dec. '39	2000
Tenn. Aero. Corp., Nashville, Tenn.	Cont. 210			2000
W. F. Luke, Schenectady Arpt., Schenectady, N. Y.	Cont. 210	325 hr.	25 hr.	1850
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B. Frame, Lovell Arpt., Chattanooga, Tenn.	Cont. 165	715 ship. 826 eng.		1495
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